SCIENCE

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THE TREND AND INFLUENCE OF CERTAIN PHASES OF TAXONOMY[1]

"ENOUGH is sometimes too much," says the newspaper philosopher. I suspect some of you are thinking right now that we have already had enough systematic botany, but as briefly as I can I wish to try to show you that while it is true that we have already had too much, it is equally true that we have had too little.

Do not feel alarmed because of the magnitude of my subject. I shall not deal with it as a whole—only certain phases of it and their influence. Before attempting my main message may I voice a plea for the old-time systematic botany? It is of course primarily the handmaid to all of the other subdivisions of the science, but apart from that is it not in itself a desideratum of no small moment?

It trains the perceptive faculties, teaches orderliness, develops judgment and strengthens reason. It is therefore a cultural course of no small significance to all who take it and, as some of us know, the source of much pleasure to many. There is a saving grace in botany not found in most of the other sciences and this is exercised through taxonomy more fully than through all its other divisions combined. Systematic work for its own sake is distinctly worth while. It develops in the student or the amateur, who achieves a fair measure of success, a feeling of confidence in himself and gives that stimulus for further mental effort that only the conquering of a definite problem affords. In this respect it may be compared to mathe-

[1] Read before the Botanical Society of America at Atlanta, December 30, 1913.

matics, with the added advantage that the flavor of the pleasure derived recurs again and again as the fields and woods minister to his life, and spring, summer and autumn, yes, and even winter, in turn speak to him who understands their glad greetings of the passing years.

Let no one imagine that it is merely easy recreation for the *dilettante* in science. It is a man's job. Any one who succeeds in systematic work would measure up well in the philosophical subjects. Manuals and keys can be made only for those who can read as much between the lines as in them; those in whom the power of discrimination becomes strongly developed but who ease up its severity by the due exercise of judgment and reason.

Systematic botany furnishes to the average layman, who is scientifically inclined, a more continuous incentive for pleasurable and inspiring contact with the world about him than any other subject that claims to be worthy of his attention. It may be that it represents the primitive phase of our development, but does not all development begin with the primitive? That some never get beyond the primitive stage is neither here nor there. The same would be found true in any other subject whatsoever. I raise the question if it is not largely true that the best botanists we have or have had began their career as systematists? Were they not led into the subject by this door? Their love for plants, their desire to know them, determined their careers. We may be evolving greater and greater men in the science, but even these must of necessity touch at least the high points in the road by which the race of botanists have attained the crowning glory of the present. The recapitulation theory is as universally applicable as the theory of evolution itself.

Let us look a little farther into the careers of those whose names have come down from a former generation. To save time we will take a single example, one who was not only a systematist, but the peer of any in his generation in every other line. His name is known to more people in America, even a quarter of a century after his death, than that of any other botanist of any time or place. His bust found its way into the "Hall of Fame" because he did more than any one else to make it possible for people to know plants. He was admired and loved in his day and now because of his "Manual" and the accompanying "Lessons." Let it not be forgotten that he would still have been a distinguished botanist had he given no thought to systematic work. His grasp of structural and physiological problems was far in advance of his time, and who knows whether even his philosophy may not prove to have been more profound than some of his critics will now admit? Dr. Gray found his way into the hearts of the people and enriched their lives by opening for them a larger world than would otherwise have been possible to them.

It is true that in all the botanical fields there are great outstanding characters whom we do not ordinarily think of as systematists. These are, however, men or women who have rendered some signal service to the race by promoting its physical or economic welfare, but even these did much of systematic work before they were able to share with others the results of their achievements. Again, to take but one example, we have in Pasteur a name that will live so long as living things are subject to attack from microorganisms. He made the race his debtor, not only by what he himself achieved in bacteriology, but by opening the way into the new field. The work of his disciples in preventing and alleviating suffering in man and beast must also in part be accounted unto him for right-

eousness. Such men, however, were entering new fields and had to create descriptions and systems of classification as a foundation for their work and as a medium of communication with their fellows. Thus we have come back to the original statement, systematic botany is primarily the handmaid to all the other subdivisions of the subject.

Having said this much in commendation of taxonomy in general, kindly permit now a brief consideration of its trend and influence. If taxonomy and taxonomists are gaining in prestige and power, if the other departments of botany are each year being better served, if the average layman in the field finds it easier to know the plants themselves we may congratulate ourselves and say that all is well. If the reverse is true, something is radically wrong. A cancer is eating its way into a vital part of the body of our science.

Taxonomists were never so numerous nor more active than now. But all activity is not necessarily progress. Motion up and down may be spectacular and nothing more. Never were there so many devoting themselves to this subject professionally as at present. Literature is piling up volume upon volume. Before we can determine whether this is progress or recession we shall have to try to find the purpose of it all. The description and classification of plants is not in itself an end. It is a means to an end and that end not for the specialist himself, but rather for his colleagues in other lines and for the great army of intelligent men and women who love plants for their own sakes.

The reasons why people may wish to know plants are many, most of them entirely worthy. No reason is more legitimate than the mere desire to know that is almost universal until our method of education, or lack of method, kills the desire. Desire that is never satisfied dies afterwhile. The child asks, "What is it?" but when it has received the answer, "I don't know; stop bothering me," seventy times seven its interest either wholly dies or it seeks outlet in other channels. The furore of enthusiasm about nature study I fear has largely spent itself. The best statement of the purpose of nature study that came to me was "It aims to keep alive the child's tentacles of inquiry." Are we not largely failing in the attainment of this meritorious aim? If so, why? As I know our schools it is primarily because of the lamentable ignorance of all nature subjects by the teachers. Not only by teachers in general, but by those professing to teach botany in our high schools. A large majority of them wouldn't know an elm from a holly or an evening primrose from a lily. I have seen them by the score in my state and most of them came from outside schools of high standing where they had been trained in the cytology of plants that they never saw and in the ecology of plants that were left behind in the dreams and environment of yesterday. You may wonder how this relates itself to my subject. But listen! There is no reason for the existence of the professional systematist (apart from the growth and pleasure it yields him personally) unless his efforts produce results that make it more easily possible for others to know the plants in which they become interested. If he fails in this one thing he fails in all. May we not judge by the indifference of the multitude to our work; by the hopelessness of the amateur who tries to acquaint himself with the plants of his district; by the distrust of their results by even professed systematists, and by the none too well concealed cynicism of our colleagues in other lines, that we are failing in this? There seems to be nearly universal agreement

that it has become increasingly difficult for every one, for any one, to state with any degree of definiteness the correct name of any considerable number of plants. That we are in a muddle is evident. That we shall never be able to clear it up I do not believe. I shall not pretend, however, that I am wise enough to tell you how this is to be done. I very much doubt if any one knows at present just what to do next, but at least no harm can come from a free discussion. If we but knew just what has gotten us into our present plight it would simplify matters, but even then the application of the remedy would be difficult. We have each so long been a law unto ourselves that it will be impossible to secure any considerable unity of action at once. Particularly will this be true if there is no agreement that a remedy is needed. Some will feel so, in spite of the fact that a large majority of the botanists of this country would subscribe to the following arraignment: Our work has been analytic, not constructive. We have dismembered organisms and held up to view their component parts. We have been looking for differences and with such amazing success that the fundamental resemblances have largely escaped our notice. We have thus produced a *pot-pourri* that is the despair of every one except ourselves, and most of us do not know how to unravel our own mysteries.

I know this is a terrible charge to lay at our own doors, but perhaps it comes with better grace from one whom others have chosen to consider as *particeps criminis*. I dare not flatter myself that I have been even one of the chief offenders, but I acknowledge with humiliation that I have had a small share in producing the disaster that has overtaken us. I now stand before you thoroughly repentant. Would that I, like the reformed inebriate or the reclaimed sinner, could preach a gospel of reform with such fiery zeal that I should reach my erring brothers.

I know that only the dead make no mistakes. We have been passing through a period of great botanical activity and he who has not made many mistakes is not much of a botanist. It is better to have been alive for a decade and have to face our errors than to have been lying immobile blankly gazing at the stars for a millennium. However, there is no virtue in mistakes as such. Our endeavor should be the maximum of activity and progress with a minimum of error and lost motion.

That the names of plants have become so unnecessarily burdened with synonyms may be partly accounted for by the following considerations.

1. We have been so busy looking for differences that we have forgotten that classification is fundamentally based upon resemblances. A distinguished systematist has said that there are two kinds of botanists—"those who see differences and those who do not." I fear that some of the former class have had their discriminating faculties over-stimulated, since species have been founded upon and keyed out upon such valueless characters as one fourth mm. in the length of the stigma and scores of others even less evident.

2. We have thrown down the old concept of a species and we find ourselves in a jungle of illy defined forms out of which we shall never be able to come until we are willing to chop out the water sprouts that grow among and often from the loftier trees. Time tests many species. It is not conclusive, but it is very presumptive evidence against their validity if, as years pass and further collections are made, no other specimens are referred to them. In examining the material in any large herbarium one finds many such hermit sheets.

Let me suggest that there are also two kinds of species, those that exist more or less well defined in nature and those that have only an academic standing. Into which category the different ones will ultimately fall is not in the power of any one mind to settle, for we recognize the truth as expressed by Dr. Gray when he said:

> Species . . . are not facts or things, but judgments, and of course fallible judgments; how fallible the working naturalist knows and feels more than any one else.

We often hear of "critical species" and arguments are multiplied to defend their retention in literature. Surely it is true that some of them are valid and stronger even when held on avowedly technical characters than some of the supposedly evident ones that have long been accepted. Nevertheless, one can not help suspecting that the condition of many of these is so "critical" that they can not long survive the untoward conditions that a general upheaval in systematic botany will superinduce.

3. Some of the synonyms are the direct result of mistakes other than that of drawing overfine distinctions. To enumerate the countless causes for these errors is neither desirable nor possible. For each there is always an explanation, not necessarily an excuse. As already stated, error is inseparable from activity. Legislation that would limit publication to those having experience and who are working in a proper environment would be desirable but for two things: (*a*) It would cut off the future supply of systematists and (*b*) it is impossible of enforcement. Since prohibition is scarcely possible and surely not desirable, regulation might be attempted. Seriously, why should any one publish a species in a genus in which the known indigenous ones are not all clear to him, unless it be in a genus separable into strongly marked sections. In that case one might work with some assurance of certainty if all the species in the section were known.

4. It sometimes proves disastrous to assume, as is often done, an inherent improbability that the same species will not be found in districts widely separated geographically. Environmental factors must be reckoned with and these have a trick of repeating themselves in far distant and most unexpected places. Mistakes would be enormously reduced if every one was expected to definitely locate the proposed species in the genus, keying out the species if necessary, or only those of the section should its sectional relationship be apparent.

It is one thing to describe a plant and say (as I and others have done) "apparently not very near any of the hitherto known species." It is quite another to so describe it that it shall be properly contrasted with its nearest ally and its setting in the genus made evident.

It is always hazardous to publish in a large genus unless the examination of its content amounts practically to a tentative monograph. Take a genus at random, *Arnica* for instance, and even a superficial examination of the material in any large herbarium will reveal a number of good species each of which has been characterized by several during the last two decades, apparently because each felt free to assume, for instance, that Colorado and Washington were, for phytographical purposes, on different planets.

5. Another source of error lies in our adherence to different codes or to no codes at all. International law and comity are swept aside. Lawlessness always did mean anarchy in political and social life, and it has brought the same result in taxonomic nomenclature. The moral is not hard to find.

6. Our strength has not all been used in the promotion of constructive work. We spend too much time in criticizing the work of others or defending our own species. Naturally our own children are much better than others, but I doubt if we gain much by rushing to their defense whenever they are attacked. This species-*making* is merely for a day; species *characterization* is for all time. It is true that they may be thrown down to-day and erected to-morrow, but in the course of time the worthy will be established and the worthless will go to synonymy. To love our own is well, but to love them so well as to be willing to juggle the testimony is vicious. Pages and pages are wasted in criticism, recrimination and the imputing of wrong motives. The inexperienced alone are convinced by such speciousness. Those who have learned wisdom know that the attacked party, were he so minded, could put up an equally effective defense. Is it not better, however, to use all available time in productive work, knowing that nothing gets its final rating until established or disestablished by critical monographic work. The one thing we can not afford to be guilty of is insincerity. We simply must deal honestly with nature and justly with the work of our fellows. Personally I would rather my whole brood should perish than to save even the most promising by dissimulation or misrepresentation.

But I must not carry the inquiry as to causes further. There are many questions I had intended to raise, but time will not permit. I must condense into a few paragraphs just a thought as to the influence of the chaotic condition of taxonomy upon the progress of our science as a whole. Morphology, physiology, ecology and economic botany in its scores of applications have all gone forward by leaps and bounds, but it is (dare I say it?) in spite of, not by the aid of taxonomy. Our unstable nomenclature, involved synonymy, multitudinous, often "half-baked" species have produced the conditions described in this paper. The effect must of necessity be to retard, to discourage, to divert effort.

Now lest I be misunderstood let me say that taxonomic work has not all been misdirected—far from it. Keenness of observation and great powers of discrimination are noteworthy in the work done. It is not so much that what has been done should not have been done, but rather that much greater effort ought to have been made to relate recent work to that which had gone before. Synthesis should have followed so closely upon the analysis of the elements of our flora that duplications would promptly have been discovered and the relation of each element to the other detected and stated.

If we will keep in mind that technical systematic work does not exist primarily for its own sake; that when it ceases to be a means of culture and pleasure to others; that when it becomes burdensome to and unworkable by our fellow botanists in other lines—the chief reasons for its existence have passed, then we shall see more clearly what yet remains to be done. We need to popularize our subject, but not by writing down to those who know little and care less, but by classifying our work so that those who wish to know shall be able to understand. We need more local descriptive floras with well-made keys and illustrations. Our manuals have become too bulky; we cover so much territory that the species are necessarily very numerous. The more species there are in a given genus the more complicated the key and the slighter the differences that separate the species. We ought to have many handbooks and pocket manuals such as the one

Professor and Mrs. H. M. Hall have given us of the Yosemite.

We have had a feeling that our manuals must cover vast sections of the country, many hundreds of thousands of square miles; that they must be complete, accounting for everything ever mentioned. As a result much is found in our volumes that describes things that do not exist, are very rare or have only historical interest for the technically trained. I am pleading for those who want to *know* the plants that relate themselves to their professional work, to their mental life or to their recreations. Please note I said know the *plants*, not know *plant names*. No one wishes to know names apart from the plants in which he is interested. Knowing the plant is first, and then a name becomes indispensable.

And why not a name instead of a manufactured phrase palmed off as an English name? In what respect is "purple-stemmed swamp beggar ticks" better than the name? We use geranium, magnolia, forsythia, and scores of others. Why not phlox, mertensia, chrysopsis or practically any other generic name? It is true this only designates the genus, but this is all that many who are intensely interested in the plants care to know, as exemplified by our use of the words clematis, chrysanthemum, lupines and roses. Those who wish to designate the species can do so with more celerity and certainty by saying *Phlox glabrata* than by smooth-leaved sweet william. In my recent "Spring Flora" I proposed this use of the generic name seriously and I wish to assert that I have seen no reason for changing my opinion.

In closing let me express the belief that we are on the eve of a new era. Already the pendulum is swinging back. The dismemberment of genera and the multiplications of species proceed more cautiously. New species will continue to be found even in this country (hundreds of them). These ought to be and will be published. So long as work is done errors must occur, but the percentage of error, let us hope, will be greatly reduced, while the disturbing effect will be minimized by more and more of constructive work of the compendium type.

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ON AN EXPERIMENTAL DETERMINATION OF THE EARTH'S ELASTIC PROPERTIES

IT is well known that the ocean tides are caused by the differences in the attraction of the sun and moon for the surface and center of the earth. These differential forces are very small compared with the attraction of the earth for bodies on its surface; in round numbers the joint tidal force of the sun and moon on a body at the earth's surface under the most favorable circumstances amounts to only about 1/10,000,000 of the weight of the body. This force would deflect the bob of a plumb line 10 feet long from its normal position only about 1/100,000 of an inch. This deviation corresponds to an angle of only .02″, or the angle which the head of a pin would subtend at a distance of 10 miles.

If the earth were a perfectly fluid mass, *i. e.*, if it offered no resistance, either elastic or viscous, to changes of shape, the surface would be tilted by the tidal forces through this same angle, and the new horizontal would be perpendicular to the new vertical. There would therefore be no change of the plumb-line relative to the earth's surface, and we could not detect the so-called "deflection of the vertical."

If the earth were perfectly rigid the plumb line would move back and forth, as the positions of the sun and moon vary, by an amount which can be calculated with an accuracy which is limited only by our knowledge of the masses and relative positions of the sun, earth and moon. As a matter of fact, the earth is partially and not entirely rigid, and therefore the excursions of the plumb line are a certain

fractional part of the full computed value. After this fraction has been found by experiment, it is possible to compute the rigidity of the earth.

In 1879 George and Horace Darwin, at Cambridge, England, attempted to measure the rigidity of the earth. They used a heavy pendulum whose motions were greatly magnified by suspending a small mirror by two fibers very close together, one of which was fastened to the pendulum bob, and the other to a rigid support. However, even with this extremely sensitive apparatus they were unable to separate any movements due to the moon's attraction from the multitude of disturbing displacements caused by changes of temperature, earth tremors, etc.

Of these disturbing elements, a very serious one is the distortion of the land caused by the immense weight of water periodically thrown upon the coasts in the ocean tides. As late as 1898 Sir George Darwin said that he doubted if it would ever be possible to isolate the effects of the tidal forces from the multitudinous disturbances of a more or less accidental character, although he recognized a possibility in the work of Paschwitz and his successor Ehlert, at Strassburg. They had already secured encouraging results by the use of the horizontal pendulum, which is in effect an exceedingly sensitive adaptation of the plumb line.

Since then measurements of this sort have been carried out by von Rebeur, Kortazzi, Hecker, Orloff and others. The experimental results are so obscured by accidental disturbances, however, that their interpretation is difficult, and the results of these various observers differ widely.

In recent years Professor T. C. Chamberlin has been much interested in the possible effect of the earth tides on the ocean tides, and he and Professor F. R. Moulton have for years been anxious to secure some definite data on the plasticity of the earth, on account of its vital bearing on questions of planetary evolution. It was through them that Professor Michelson became interested in the problem of measuring the elastic properties of the earth and designed the experiments which were conducted last autumn on the grounds of the Yerkes Observatory, at Williams Bay, Wisconsin. These experiments are described in full, with graphs and tables of observations, in the *Journal of Geology* and in the *Astrophysical Journal,* for March, 1914.

Professor Michelson's idea was to substitute a long horizontal water surface for a long pendulum, and measure the changes of level at its ends. There are many advantages in this arrangement. The length may be increased to any desired extent. The water column may be entirely under ground and thus, to a very large extent, freed from temperature disturbances. Earth tremors produce but little if any effect.

The arrangement actually used was as follows. An iron pipe, 500 feet long and 6 inches in diameter, was buried in a trench 6 feet deep along an accurately determined east and west line. At each end there was a pit 10 feet deep and 8 feet square, walled with concrete. The pipe was leveled, certainly to within one half inch, and probably to within one quarter of an inch, and half filled with water. A gauge at each end was connected at the top to the air space in the pipe, and at the bottom to the water. A needle point in each gauge was brought up from below until it nearly touched the surface of the water. The needle point was illuminated through a window in one side of the gauge by a small electric flash light. The under surface of the water formed a very perfect mirror, and the distance between the pointer and its totally reflected image was read, through a second window, with a micrometer microscope. Gauges, pipe and windows were all air-tight, so that fluctuations in barometric height at the ends were without effect. If the gauge at one end was open, the image at the other was not steady, but when both ends were closed, the reflected image was as steady and sharp as the pointer itself. Microscopes were used for which a millimeter at the focus corresponded to about 17 revolutions of the micrometer head. Observations were taken by measuring the distance between the pointer and its image at one end of the pipe,

and subtracting the corresponding difference at the other end. As the water moved, *e. g.*, toward the east end of the pipe, in response to the tidal forces, the difference (*E*) at the east end increased, since the water was rising higher above the pointer, and the difference (*W*) at the west end diminished as the water fell there. The difference *E–W* therefore increased from hour to hour. When the water moved toward the west end of the pipe, the difference (*E*) decreased and (*W*) increased, and *E–W* diminished. The values of *E–W* plotted as ordinates against the time as abscissas, gave curves which represented the observed tides. Since the water moved down at one end and up at the other, and since the reflected images moved twice as far as the water surfaces, a fourfold magnification was secured. Moreover, since any change in level which might be caused by small changes in temperature or leaking altered the level at both ends alike, the errors caused by such disturbances disappeared in the double difference *E–W*. Changes in level due to the settling of the pipe between the ends were also without effect. If, however, one end settled more than the other, the double difference would increase or decrease, depending on whether the east or west end settled more rapidly, and the whole curve would be given an upward or downward slope. A similar effect would also occur if there were an appreciable change in the slope of the rock strata. But since such changes were not periodic, they would not affect the result seriously.

About eighteen or twenty readings per day, at intervals of from one to three or four hours, were taken during August, and it became evident that the method was capable of yielding very accurate results. A similar line was therefore installed in a N.–S. direction. During October and November readings were taken by the writer on both the N.–S. and E.–W. lines, with the assistance of Mr. Harold Alden, of the Yerkes Observatory staff. Readings were taken once an hour from 6 A.M. to 12 P.M. and once in two hours from 12 P.M. to 6 A.M. About four minutes usually elapsed between readings at one end of a line and the other. The mean time of the two was taken as the time of the observation. The result was the same as if the two ends had been read simultaneously at the mean time. The observations began at 8 A.M., September 27, and ended at 2 P.M., November 29, 1913.

The curves representing the tides in both the E.–W. and N.–S. pipes were very satisfactory. They showed with great faithfulness tides of the expected form, including the diurnal inequality, and spring and neap tides. The actual change of level at each end at spring tide amounted to about 0.001 inch.

But securing these observations was not all of the problem. It was necessary to know what the tides in the pipes would have been if the earth were absolutely rigid. Computations to determine them were made by Mr. W. L. Hart under the direction of Professor F. R. Moulton. The tidal forces acting on the water in the pipes depend on the positions of the sun and moon relative to the observer. These positions change in a very complicated manner. In the first place, the moon rises in the east and travels westward across the sky because of the earth's rotation. The moon has a motion eastward among the stars, completing a revolution around the earth in a month. Besides this eastward motion, it makes each month an excursion from 28° (at the present time) north of the celestial equator to 28° south of the celestial equator. Its distance from the earth varies by about 10 per cent. during the month, and its eastward motion among the stars is far from being uniform. In addition to all these things the attraction of the sun on the moon causes its motion to be more irregular than it would otherwise be, and it never moves around the earth twice in the same orbit. When all of these complex changes are properly compounded with the almost equally complex ones coming from the sun, the variations in the actual tidal forces are obtained.

Fortunately the Ephemeris gives us the positions and distances of the moon and sun for every hour, thus saving an enormous amount of computation. Even with this aid the work of computing the tides in the pipes

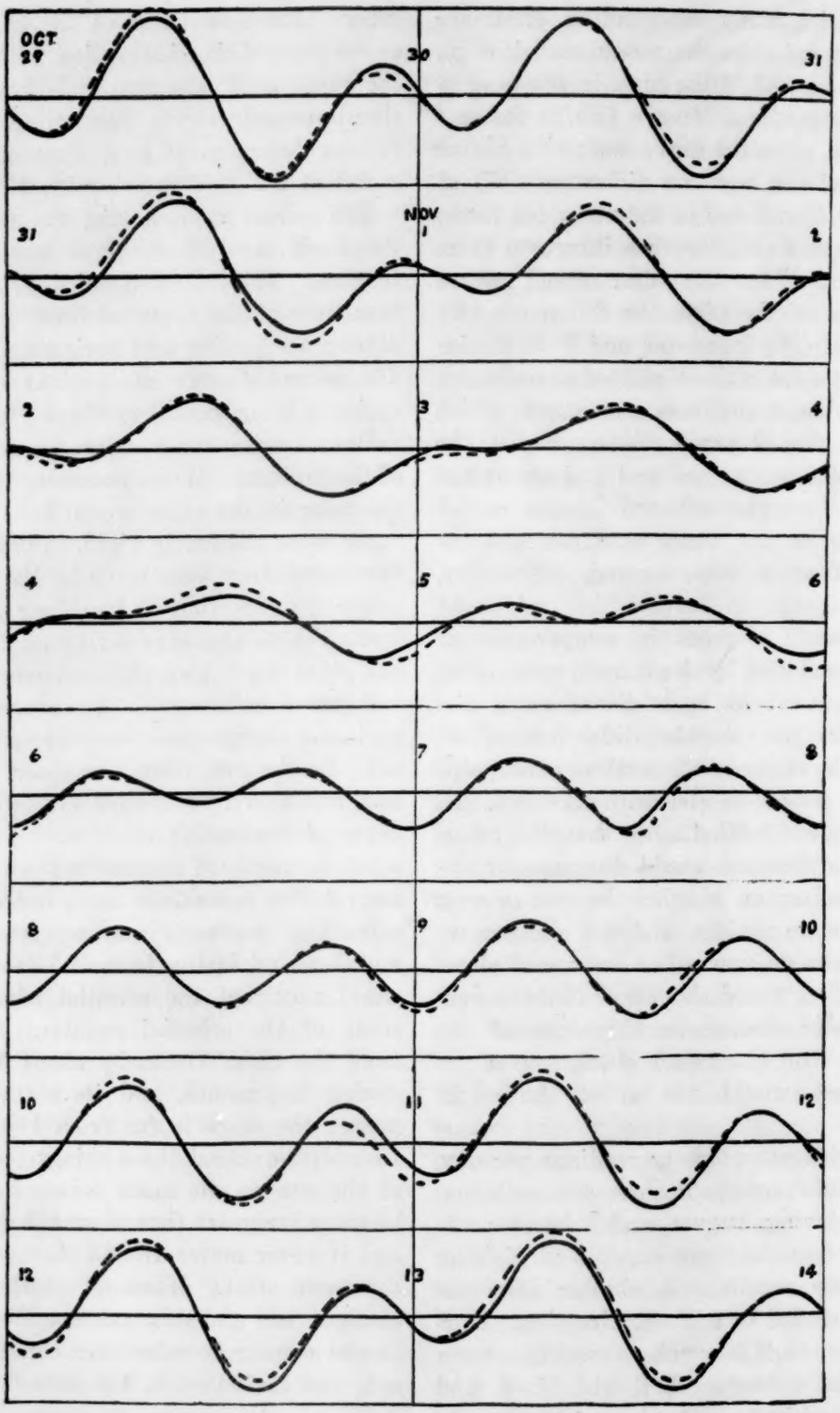

FIG. 1. E.–W. Dotted curve, observed values; full curve, 0.7 of calculated.

was very great. As the experiment progressed and the order of accuracy in the observations was seen to be high, it became necessary to increase the rigor of the computations. It was found necessary, for example, to take account of the fact that the tidal force of the moon is greater on the side of the earth next to the moon than on the opposite side. This

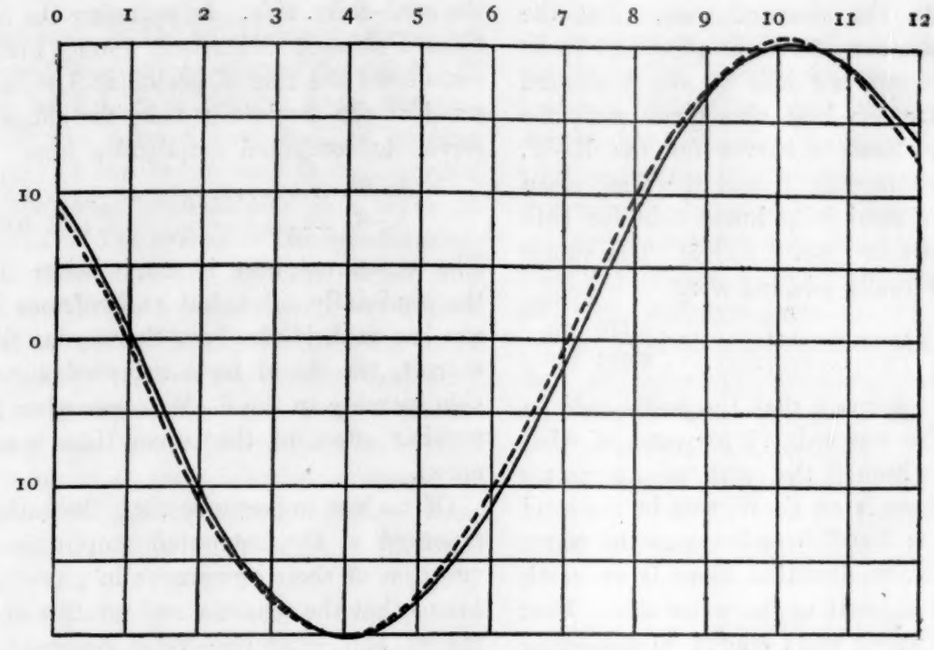

FIG. 2. E.–W. Mean of all observations, semi-daily lunar tide. Dotted curve, observed values; full curve, 0.7 of calculated.

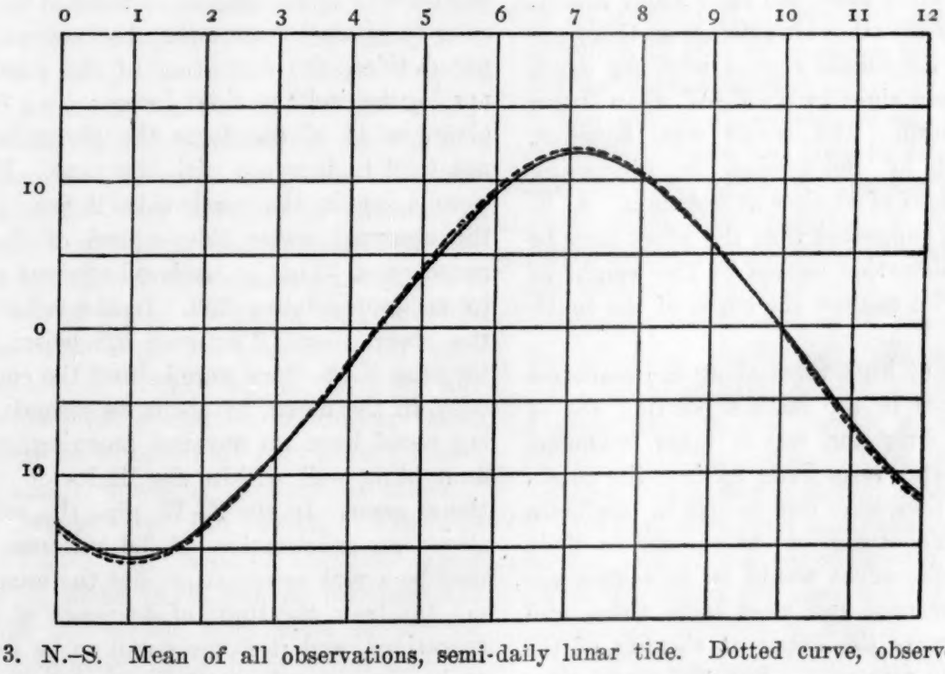

FIG. 3. N.–S. Mean of all observations, semi-daily lunar tide. Dotted curve, observed values; full curve, 0.5 of calculated.

refinement has not heretofore been necessary in work on the tides, but it introduces differences of as much as 3 per cent. In its final form Professor Moulton's formula, including harmonics of the third order, took account of all factors which affected the result by as much as 1 per cent., the probable accuracy of the experimental work.

In comparing the observed and computed tides in the E.–W. pipe, Professor Michelson found that if the computed tides were multiplied by the factor 7/10 they agreed almost

perfectly with the observed ones. But the computed tides for the N.–S. pipe had to be reduced to about one half of the computed values to give the best agreement with the observations. Sample curves for the E.–W. line are given in Fig. 1, and the final mean values of the semi-daily lunar tide for both lines are given in Figs. 2 and 3. The values of the ratios finally adopted were

E.–W.	0.710
N.–S.	0.523

These figures mean that the water tide in the E.–W. pipe was only 71 per cent. of what it would have been if the earth were perfectly rigid, *i. e.*, there is an E.–W. tide in the solid earth which is 290/710 as large as the water tide. In a N.–S. direction there is an earth tide 477/523 as great as the water tide. That is, the earth yields more readily to distorting forces in the N.–S. direction than in the E.–W. direction. Twice each day the surface of the solid earth rises and falls about a foot.

This result is rather surprising, as there appears to be no simple reason why the earth should be more rigid in an E.–W. than in an N.–S. direction. The result was, however, foreshadowed by Schweydar, in discussing the observations of Hecker at Potsdam. A. E. H. Love has suggested that the effect may be due to the distortion caused by the weight of the ocean tides against the edges of the continents.

The times of high tides along the seacoasts with reference to the moon's position are of course very irregular, but if these enormous masses of water were flung against the coasts at the time they were due to rise in obedience to the moon's attraction, there can be little doubt that the effect would be to reduce appreciably the east and west earth tides, and thus to increase the apparent rigidity of the earth in this direction. But the ocean tides are so very complex that there appears to be little prospect of making accurate calculations on this point at present.

Added significance is given to the possibility that the ocean tides are responsible for the difference between the E.–W. and N.–S. rigidity by a consideration of the daily, instead of the semi-daily, tide. In reducing the observations Professor Michelson found that if he considered the tide of period 25.812 hours, instead of the semi-daily tide, the ratios of observed to computed amplitudes were

E.–W.	0.72
N.–S.	0.66

The agreement here is much better than for the semi-daily tides, but as Professor Michelson has said, if the Love-Schweydar theory is correct, we would have expected a considerable increase in the E.–W. ratio, when the disturbing effect of the ocean tides was eliminated.

Of no less importance than the ratio of the observed to the computed amplitudes is the question of their agreement in phase. It was found that the maxima and minima of the observed and computed tides occurred almost exactly simultaneously. The difference in phase furnishes a measure of the plasticity or viscosity of the earth. If there is no difference in phase between the observed and computed tides, the distortion of the earth does not lag behind the tidal forces; *i. e.*, for any given value of the force the distortion does not tend to increase with the time. If there were a lag in the earth tide, it would throw the observed water tides ahead of the computed ones. This is rendered obvious at once by an appropriate graph. In the reduction of the observations, Professor Michelson found that the N.–S. tides were behind the computed ones, in the mean, by about 24 seconds. This lag could have no physical meaning, and the amount is well within the limits of observational error. In the E.–W. pipe the reduction shows an acceleration of 3.6 minutes. This may be a real acceleration, but the quantity is not far from the limit of accuracy of the observations, and it is too small to be regarded as highly accurate.

The agreement of phase between the observed and computed waves is of great importance for the theories of planetary evolution. Darwin's theory of planetary fission, *i. e.*, the breaking off of the moon from the earth and its subsequent withdrawal to its present distance, is based on the assumption

that tides exist in the solid masses, which are of a viscous and not an elastic character. If tides are raised in a viscous body the protuberances are carried past the line joining the centers of the bodies and the differential pull on the protuberances acts as a brake on the motions of the system. The resulting effect is to slow down the rate of rotation and increase the distance between the two bodies. The tidal theory of the evolution of the moon depends chiefly on the assumption that such tides exist in the earth. The results of this experiment show that the earth-moon system has not undergone the evolution supposed by Darwin unless the interior conditions were formerly vastly different from what they are at present.

Professor Moulton's calculations show that if the ratio of the observed to the calculated tides is taken as 0.70 and the acceleration of phase as the mean of the E.–W. and N.–S., *i. e.*, 1.8 minutes, the mean rigidity of the earth is about 8.6×10^{11}, and the viscosity is 10.9×10^{16}, in C.G.S. units. These are of the order of magnitude of the rigidity and viscosity of steel. These calculations assume that the distortion decreases in geometrical progression as the time increases in arithmetical progression, and that the substance of the earth is homogeneous, a condition which does not, of course, exist. We may say, however, that the earth tides are approximately what they would be if the earth, through and through, had the properties of ordinary steel.

It would be a matter of very great interest to have similar series of observations taken at various places on the earth. Professor Chamberlin is very hopeful that the whole problem of ocean tides, now so intricate and apparently insolvable, may yield to investigations conducted along lines which take account of the joint action of the water tide and body tide. There can be no doubt, as he has pointed out, that the tides in many places are largely influenced by the rocking of the basins. It would be necessary to conduct a number of investigations like the one herein described in different regions to give definite knowledge of the facts as to the amount of the body tide, together with an ample series of inspections of the basins of the great water bodies. Professor Chamberlin also believes that we should have further investigations of this kind on account of their bearing on vulcanism and seismic disturbances. These phenomena are almost certainly connected with the elastic state and degree of rigidity of the earth-body and of its different parts.

It is Professor Michelson's intention to install an automatic recording device, and to continue the observations at Yerkes Observatory by interference methods. A considerably higher degree of precision is expected.

HENRY G. GALE
THE UNIVERSITY OF CHICAGO

EDUARD SUESS

EDUARD SUESS, dean of modern geology and geologists, passed away on April 26, 1914, in the fullness of his eighty-three years, revered by all students of his chosen earth science and loved by all who came under the influence of his warm personality.

The son of a German merchant of Jewish extraction, Suess was born in London on August 20, 1831. Here his parents resided until 1834, when they removed to Prague, and eleven years later to Vienna, where the youth was destined to rise to great eminence in the university, in the council of the city, and in the Austrian parliament. Suess was born and lived in an environment that made of him a great linguist, and during a period of his life it is said that he acquired a new language each year. Certain it is that he was at home in many tongues; and more than once, on receiving one of his characteristic letters, has the writer noted the ease with which he expressed his thoughts in English.

While in the Polytechnic School, it became apparent that Suess's natural bent was wholly toward natural history studies, and at nineteen years of age he published his first paper, a short sketch of the geology of Carlsbad and its mineral waters. In 1851 he was appointed as assistant in the geological department of the Royal Natural History Museum at Vienna, where for the next eleven years he devoted

himself to paleontology, and chiefly to brachiopods of the Paleozoic and Mesozoic eras. The comprehensiveness of his mind evinced itself even in these early years, for in 1859 and 1860 appeared a little book of 122 pages, entitled "Die Wohnsitze der Brachiopoden," in which he examines the living species, seventy-six in number, and from this draws certain conclusions as to the probable habitats of the fossil forms.

At the age of twenty-four he married the daughter of Dr. Strauss, a distinguished physician in Prague, and, as has been said by Geikie, "entered on a life of great domestic happiness, which largely contributed to the success of a strenuous career wherein science and politics came to be strangely blended."

Geikie says further:

> From his youthful days, when he described the Carlsbad springs, he had been interested in underground waters, and among the inquiries which he pursued while attached to the museum was one that embraced the relations of the soil and water supply of Vienna to the life of its inhabitants. In 1862 he published a small volume on this subject, in which he gave a comprehensive account of the economic geology of the district. At that time the city was suffering from an impure water supply and consequent typhoid fever. The luminous essay of the young professor at once attracted attention. He was the same year elected into the town council, that he might give the benefit of his advice in the steps to be taken towards the attainment of better sanitary arrangements. He boldly advocated a scheme for bringing the abundant pure water of the Alps into Vienna by means of an aqueduct 110 kilometers in length. This project, eventually adopted, was brought to a successful termination in 1873. So grateful were his fellow-citizens for the signal service thus conferred on them that they bestowed on him their highest civic distinction by electing him an honorary burgess. By this time he had made his mark in the town council as one of its most useful and able members, so that it was not surprising that he should have been chosen as one of the parliamentary representatives. For more than thirty years he sat in the Austrian parliament as a powerful leader of the Liberal party, only retiring in 1896, when advancing age made the strain of the two-fold life as a politician and man of science too great to be longer borne.

As a geologist and a member of parliament, it was natural for Suess to be deeply interested in the future supply of the monetary metals, gold and silver. He writes:

> Some years after the introduction of the gold standard in Germany, I published, in 1877, a small work, "Die Zukunft des Goldes," wherein I tried to show that from geologic indications we must expect in the future a scarcity of gold and an abundance of silver, and that the extension of the gold standard to all civilized states is impossible.

In 1892 he published his "Die Zukunft des Silbers," and this work was so well thought of that an English translation was ordered and with the author's consent was published in 1893 by the finance committee of the United States Senate. At that time his predictions were being verified; gold was becoming scarcer, and silver kept on increasing in quantity in spite of its falling price. He says:

> Under these circumstances many of my friends and myself were of the opinion that Austria-Hungary, in order to guard herself against all contingencies, ought indeed gradually to acquire a moderate amount of gold, but ought neither to proclaim a gold standard nor establish a definitive ratio between the silver florin and the gold coin.

At the age of twenty-six, Suess was appointed professor extraordinary and in 1867 was promoted to full professorship in the University of Vienna, and for forty-four years he remained a great and enthusiastic teacher, retiring with the title emeritus at the age of seventy. Among his students may be mentioned Neumayr, Mojsisovics, Fuchs, Waagen and Penck.

The greater part of Suess's long life was devoted to working out the evolution of the features of the earth's surface. The problem of mountain-building presented itself to his mind during his many excursions in the eastern Alps, and in 1875 he stated his views thereon in the small volume called "Die Entstehung der Alpen," an octavo of 168 pages. Up to this time his publications numbered sixty titles, his studies having ranged over nearly all the branches of geology.

"Die Entstehung der Alpen," to quote again from Geikie,

contains the germ of those later contributions to science which have placed him on so conspicuous an eminence among the geologists of the day. It sketches the general principles of mountain-architecture, especially revealed by a study of the Alpine chain. But he did not confine his view to the particular area with which he was himself personally familiar. Already his eye looked out on the wider effects of the unequal contraction of the terrestrial crust, and swept across the European continent eastward into Asia, and westward across the Atlantic into America. . . . To thoughtful students of the science this treatise, in his firm hold of detail combined with singularly vivid powers of generalization, was full of suggestiveness. But the interest and importance of its subject did not obtain general recognition until it was followed ten years afterwards (1885) by the first volume of the great "Antlitz der Erde"—the work which has chiefly given Suess his place among his contemporaries, and by which his name will be handed down to future time. In its striking arrangement of subjects, in its masterly grouping of details which, notwithstanding their almost bewildering multiplicity, are all linked with each other in leading to broad and impressive conclusions, and in the measured cadence of its finer passages, the "Antlitz" may be regarded as a noble philosophical poem in which the story of the continents and the oceans is told by a seer gifted with rare powers of insight into the past.

The writer had the great pleasure of meeting Suess during the Ninth International Geological Congress held at Vienna in August, 1903. Tall and powerful, decisive and yet kind, his great head covered by the familiar soft felt hat, the man left an indelible impress upon my memory during the hour in which we talked of paleogeography, seas and barriers. To me the personal interview was memorable, but the great mental power and vivid imagination of the master mind naturally showed to better advantage at the farewell banquet given by the congress at the Hotel Continental on the evening of August 27. Tietze, presiding as president of the congress, gave the official farewell in French. Following him, and speaking in his own tongue, came Geikie, telling of his first visit to Vienna forty years since, and saying that of those he met at that time nearly all were gone excepting Suess, then a young man of great prominence, since known to all geologists through his masterly work "Das Antlitz der Erde." This reference to the time when Geikie and Suess—both of whom later became storm-centers in geology—were young, visibly affected the latter. Toward the end of the speaking he arose and with bowed head and in a low voice which increased to greater volume as he went on, he made in German a most eloquent appeal to geologists to rise to ever greater and better work. Unfortunately no one was at hand to take down what he said, and so after the dinner I asked him if he would be so kind as to put his speech in writing. This he did a few days later and a translation of it appeared in the *American Geologist* for January, 1904. In part this is as follows:

> Returning to his earth the geologist perceives that the sum total of life's phenomena not only forms a single phenomenon, but that it is also limited by space and time. It occurs to him now that the stone which his hammer strikes is but the nearest lying piece of the planet, that the history of this stone is a fragment of the history of the planet, and that the history of the planet itself is only a very small part of the history of the great, wonderful, ever-changing Kosmos.
>
> His heart then thrills; he feels called as a colaborer on the most sublime problems in which feeble mortal beings can take part. Then, too, he sees that the fundamental lines of structure coursing over the earth's surface have nothing to do with the political lines separating the nations. The vastness of the problem itself makes the concord of civilized nations natural, and they remain separated only through their emulation, all filled with the idea that mankind in general will most highly esteem that nation which is in the position to offer the most and the best of noble example, of new truth and of ideal worth.

CHARLES SCHUCHERT
YALE UNIVERSITY

SCIENTIFIC NOTES AND NEWS

SURGEON GENERAL W. C. GORGAS has received the degree of doctor of laws from Yale University and from Princeton University.

THE degree of LL.D. was bestowed by the University of California on commencement day on Eugene Woldemar Hilgard, from 1874

to 1906 professor of agriculture and dean of the College of Agriculture; upon George Holmes Howison, Mills professor of intellectual and moral polity in the University of California from 1884 to 1909; and on William Mulholland, the engineer.

At its recent commencement Wesleyan University conferred the degree of doctor of science on Dr. Walter P. Bradley, who has this year retired from the professorship of chemistry which he had held since 1893.

Dean Frank D. Adams, of McGill University, school of applied science, received the honorary degree Sc.D. at the Tufts College commencement. Incidentally he spoke at the annual dinner of the Association of Harvard Engineers and Dr. and Mrs. Adams were the guests of the geologists of Greater Boston at a dinner at the University Club.

On the occasion of the opening of the new physiological laboratory at the University of Cambridge on June 9, the degree of doctor of science was conferred on Sir William Osler, Sir David Ferrier, Sir Edward Schäfer and Professor E. H. Starling.

The first award of the Chandler gold medal was made to Dr. L. H. Baekeland when the Charles F. Chandler lectureship at Columbia University was inaugurated by an address given by him.

The Royal Society of Arts will confer the Albert medal for the current year on Chevalier Guglielmo Marconi, "for his services in the development and practical application of wireless telegraphy."

The Geological Society of London has elected to foreign membership Dr. F. J. Becke, professor of mineralogy at Vienna; Dr. T. C. Chamberlin, professor of geology in the University of Chicago; Dr. F. J. Loewinson-Lessing, professor of mineralogy and geology at St. Petersburg; Dr. A. P. Pawlow, professor of geology and paleontology at Moscow; Dr. W. B. Scott, professor of geology in Princeton University; Dr. P. Choffat, Geological Survey of Portugal, and Dr. Charles R. Van Hise, president of the University of Wisconsin.

Director William Wallace Campbell, of Lick Observatory, has gone to Russia on the Crocker Expedition to observe a total eclipse of the sun. For this purpose Regent William H. Crocker gave $5,800 to the University of California.

Dr. Simon Flexner and Dr. Peyton Rouse, of the Rockefeller Institute for Medical Research, have gone to Spartanburg, S. C., to study the situation in regard to pellagra.

Mr. J. S. Diller, geologist of the United States Geological Survey, has gone to Mount Lassen to prepare a report on the eruptions of the peak.

On June 23, Dr. Alexander G. Ruthven and Mr. Frederick M. Gaige, of the museum of zoology of the University of Michigan, sailed for British Guiana, where they will carry on zoological field studies. The principal field work will be the study of the local distribution and habits of the amphibians, reptiles and ants, and the gathering of extensive collections of amphibians, reptiles, ants, molluscs and crustaceans. An attempt will also be made to secure specimens in a few groups other than those mentioned, particularly in those needed to fill out the synoptic collections in the museum.

A party from the Peabody Museum of Yale University, under the leadership of Professor R. S. Lull, is to explore the Miocene along the Niobrara River, Nebraska, this summer, in the hope of securing additional fossil vertebrate material to supplement the great Marsh collection at Yale.

Dr. Robert K. Nabours, professor of zoology in the Kansas Agricultural College and zoologist of the Kansas State Experiment Station, sailed on May 19 for Rotterdam. He will visit for the college the agricultural experiment stations of Russia, Turkestan and Central Asia, making special study of the work in animal genetics and securing specimens for his experiments. On the return trip he will visit experiment stations in Germany and other European countries.

Dr. Charles H. Ellwood, professor of sociology in the University of Missouri, has been

granted a sabbatical year's leave of absence, and will spend the larger part of his time in England studying social conditions. Dr. L. L. Bernard, professor of sociology in the University of Florida, will have charge of the work in sociology in the University of Missouri during Professor Ellwood's absence.

PROFESSOR L. E. DICKSON, of the University of Chicago, will be visiting professor of mathematics in the University of California from August to December, 1914.

DR. C. H. T. TOWNSEND, director of the entomological station at Lima, Peru, should after July 1 be addressed at the U. S. National Museum.

ON June 4 a number of plant pathologists of the Pacific Coast, meeting at Davis, Cal., formed a Western Branch of the American Phytopathological Society. The following officers were elected: *President,* Ralph E. Smith, Berkeley, Cal.; *Vice-president,* H. S. Jackson, Corvallis, Ore.; *Secretary,* W. T. Horne, Berkeley, Cal.

AT the annual meeting of the Medical Research Club of the University of Illinois, Dr. Wm. H. Welker was elected president and Dr. J. J. Moore, secretary, for the next academic year.

THE annual address before the graduating class of the School of Medicine of the University of Alabama, at Mobile, was delivered by Surgeon General William C. Gorgas.

DR. JOHN F. ANDERSON, director of the Hygienic Laboratory, U. S. Public Health Service, delivered the annual address, on June 9, before the Alumni Association of the College of Medicine, Syracuse University. The subject of his address, which was illustrated with lantern slides, was "The United States Public Health Service: its Organization, its Work and its Accomplishments."

A MONUMENT to Captain Scott and the companions who perished with him will be unveiled during the summer at Finse, Norway. The memorial will be nearly 20 feet high, and will bear the names of the explorers, with the inscription, in Norwegian, "The South Pole, January, 1913. Erected by Norwegians." The funds for the monument have been raised by a newspaper, and donations have been contributed by the Norwegian government, the Geographical Society, and a number of prominent men from all parts of the country.

THE seventh centenary of the birth of Roger Bacon was commemorated at Oxford on June 10 by the unveiling of a statue in the University Museum and by the delivery of a series of addresses. The statue, which is the work of Mr. Herbert Pinker, was unveiled by Sir Archibald Geikie, and was accepted on behalf of the university by the chancellor, Lord Curzon, of Kedleston. It presents Bacon in the habit of a Franciscan friar, holding in his hands an astrolabe with a desk in front of him. It is a full length figure in white marble.

DR. RUPERT NORTON, assistant superintendent of the Johns Hopkins Hospital, died on June 19, of typhoid fever.

DR. JOSEPH REYNOLDS GREEN, F.R.S., known for his important researches in plant physiology, fellow and lecturer of Downing College, Cambridge, and formerly professor to the Pharmaceutical Society of Great Britain, died on June 3.

THE U. S. Civil Service Commission announces an examination for metallurgical engineer, for work in iron and steel, eligibles to fill a vacancy in this position in the Bureau of Mines, Department of the Interior, for service at Pittsburgh, Pa., at a salary ranging from $3,000 to $4,500 a year.

THE medical school of the University of Minnesota has adopted the principle of teaching fellowships in the clinical departments, with the end in view of providing well-trained full-time assistants and research workers and at the same time giving a basis for graduate instruction in the various specialties. It is arranged that the fellowships be in three grades; viz., first year, $500; second year, $750; third year, $1,000. To be eligible to a first year fellowship a candidate, as a general rule, must have received his M.D. degree from an acceptable school and have served one year as interne in a good hospital. The fellows ap-

pointed under this system will give their entire time to study, research and such assisting in clinics as they may be prepared for. A course of study will be laid out for each fellow, adapted to prepare him for the specialty chosen by him. This course will include work in the laboratory branches, dispensary service, hospital service and investigation. It is probable that the course (of two or three years?) will lead to a degree properly recognizing the specialty in which the candidate has worked. Arrangements may be made whereby these fellows can spend one year at the Mayo Clinic and count the same toward the advanced degree. In order to inaugurate the system the board of regents of the university has authorized the following teaching fellowships for the next school year: one each in medicine, in surgery, in obstetrics and gynecology and in eye, ear, nose and throat, each of $500. There is also provision for one $500 fellowship and one $1,000 fellowship in mental and nervous diseases, or in lieu of these a $1,500 instructorship.

The Geological Survey has completed its preparations for the annual campaign of investigating the mineral resources of Alaska, the field plans for the year having been approved by Secretary Lane. Eleven parties will be put in the field this year, and as in the past special heed will be given to the investigation of the resources of those districts which are tributary to the several routes that have been advocated for the proposed government railways. A party under the leadership of J. W. Bagley and Theodore Chapin will undertake the exploration of the region tributary to Talkeetna River and will connect with the surveys of the Broad Pass region made last year. An exploration of the region lying between Lake Clark on the east and the Iditarod district on the west will be undertaken by R. H. Sargent and Philip S. Smith. A. G. Maddren will investigate the goldplacer districts tributary to the lower Kuskokwim. He will ascend Iditarod River by canoe, portage across the divide to reach the Kuskokwim, and visit the Anniak, Tuluksak and Goodnews Bay placer districts. Stephen R. Capps and C. E. Giffin will carry geologic and topographic surveys across Skolai Pass into the White River basin and thence to the international boundary. A detailed base map will be made of part of the Juneau district, now the most important gold lode camp in Alaska and promising to become one of the most important on the continent. D. C. Witherspoon will undertake the making of the map, which will be on a scale of three inches to the mile. A survey of the Kotsina copper-bearing area was undertaken in 1912. It is planned that F. H. Moffit and J. B. Mertie now complete this work. B. L. Johnson, with one assistant, will undertake the detailed geologic survey of the Port Valdez gold and copper district. To coordinate and correlate the various geologic surveys in Alaska it is necessary to continue the studies of the general geology and mineral resources. Three geologists will be engaged in this work during 1914. George C. Martin, assisted by R. M. Overbeck, will continue his studies of the Mesozoic stratigraphy. He will visit localities in southeastern Alaska, in the Chitina Valley, and along the Yukon. H. M. Eakin will undertake supplementary investigations of the tin deposits of Alaska. Alfred H. Brooks, the geologist in charge of the Alaska surveys and investigations, expects to leave for Alaska as soon as office work permits. He will study especially the problems of Quaternary geology, including the genesis and occurrence of placer deposits. He will visit the Iditarod and Fairbanks districts and, time permitting, the Nome district. Mr. Brooks will also join the Moffit party in the Kotsina district and the Johnson party in the Valdez district for brief periods of time.

Dr. W. P. Herringham, vice-chancellor of the University of London, and Sir Alfred Pearce Gould, chairman of the Brown Institution Committee, write to the London *Times* with reference to the movement for further university research into the causation of swine fever and other animal diseases; that the work of the Brown Animal Sanatory Institution belonging to the University of London has not

been generally recognized. They say that: "The Brown Institution was founded under the will of Mr. Thomas Brown of Dublin, who died in December, 1852, and left about £20,000 to the University of London for the purpose of 'founding . . . an institution for investigating, and, . . . endeavoring to cure maladies, distempers and injuries, any quadrupeds or birds useful to man may be found subject to.' . . . The institution, at 149 Wandsworth-road, was opened in 1871. Many of its researches have been carried out at the instance and on behalf of government departments, and the diseases investigated have been numerous and diverse in character, including anthrax, actinomycosis, hydrophobia (for the Hydrophobia Commission), vaccinia (for the Local Government Board), tuberculosis, swine fever (for the Board of Agriculture), and sleeping sickness. We may refer particularly to the research on Johne's disease of cattle by Mr. F. W. Twort, the present superintendent of the institution, and Mr. G. L. Y. Ingram, who succeeded in growing outside the animal body the causative bacillus of the disease. The work had to be curtailed owing to the fact that the institution was unable to provide the funds necessary for the keep of infected animals for experimental purposes. We are thoroughly in agreement with the Berks and Oxon Chamber of Agriculture that such investigatons are best carried out in a place like a university. We beg further to point out that in the Brown Institution the University of London has the nucleus of exactly such a research department as is required, and that nothing but adequate funds are needed for its further development."

UNIVERSITY AND EDUCATIONAL NEWS

AT the celebration of the centenary of the foundation of the Yale University Medical School, large gifts were announced in addition to the $500,000 from the General Education Board. These included a provisional gift of $500,000 for the Anthony N. Brady foundation and $600,000 from donors not officially named.

BY the will of James Campbell, the St. Louis University Medical School will receive his entire estate after the death of his heirs, who have a life interest in it. The present value of his estate is estimated to be from $15,000,000 to $40,000,000.

BY the will of Thomas W. Holmes, of Troy, Rensselaer Polytechnic Institute is bequeathed the sum of $50,000.

BY the will of the late Dr. Joseph D. Bryant, professor of surgery in the University and Bellevue Hospital Medical College, a trust fund of $1,000 is established for the benefit of New York University. The directions regarding it left by Dr. Bryant were as follows: "The income of this fund shall be devoted to instilling in the minds of the senior class the principles of ethics of the American Medical Association." Upon the death or remarriage of his widow, one seventh of Dr. Bryant's residuary estate is to be given in trust to New York University, and one seventh in trust to the New York Academy of Medicine. One contingent bequest of $10,000 is to be devoted to opposing the efforts of anti-vivisectionists in New York State.

MISS SUSAN MINNS has given $50,000 to the department of botany of Wellesley College, in memory of Susan M. Hallowell, the former head of the department.

SIR GEORGE KENDRICK has given $90,000 to the University of Birmingham to endow the chair of physics in memory of the late Professor John Henry Poynting.

THE trustees of Columbia University have appointed Dr. Warfield T. Longcope, to be Bard professor of the practise of medicine to succeed Dr. Theodore C. Janeway, who goes to the Johns Hopkins University. Professor Longcope is also nominated medical director of the Presbyterian Hospital. The department of therapeutics has been merged with that of clinical medicine and Dean Samuel W. Lambert, formerly professor of therapeutics, has been appointed professor of clinical medicine. Dr. Charles C. Lieb has been appointed assistant professor of a new department of

pharmacology and Dr. William Darrach has been appointed assistant professor of surgery.

Dr. Ross A. Gortner, since 1909 resident investigator in biological chemistry at the station for experimental evolution of the Carnegie Institution of Washington, has been appointed associate professor of soil chemistry in the University of Minnesota.

Dr. Karl F. Meyer, whose special field is the tropical diseases, has been promoted to be professor of bacteriology and protozoology in the University of California.

Dr. J. Howard Agnew, formerly first assistant in the department of medicine, University of Michigan, has accepted the full time professorship in medicine in the University of Alabama, School of Medicine, at Mobile.

At Dartmouth College, Drs. E. J. Rowe and E. S. Allen have resigned as instructors in mathematics, the latter to accept an instructorship at Brown University. Dr. R. D. Beetle, of Princeton University, and Dr. L. C. Mathewson, of the University of Illinois, have been appointed instructors in mathematics.

D. K. Picken, professor of mathematics in Victoria College, University of New Zealand, has been appointed master of Ormond College, Melbourne University.

DISCUSSION AND CORRESPONDENCE

DADOURIAN'S ANALYTICAL MECHANICS

In the issue of Science of April 3, Dr. Dadourian replies to my criticism of his "Analytical Mechanics." His reply was read with interest. It was hoped that he would clear up several points in this reply that seemed to the reviewer as unsatisfactory. I do not wish to get into a controversy, but it seems to me that his standpoint is untenable. He says in his reply:

> It is a fact that I have applied vector addition to forces *without hesitation*, but I have shown as little hesitation in treating velocities, accelerations, torques, linear momenta and angular momenta as vectors. Why did not Professor Rettger accuse me of having assumed the "parallelograms" of these magnitudes? Is the "parallelogram of forces" more of a dynamical law than the parallelogram of torques, for instance? The parallelogram law applies to any vector and is not at all a characteristic of forces, therefore, it is not a dynamical law. It does not even deserve being called a "law" when applied to a special type of vectors. In its most general form the "parallelogram law" is the principle of the independence of mutually perpendicular directions in space, a purely geometrical principle. . . . After devoting an entire chapter to vector addition and after defining force as a vector, to introduce the "parallelogram of forces" as a new law, as Professor Rettger would have it, could serve only to show that the man who did it could not have a clear conception of the meanings of the terms he was using.

Let us assume that a body, originally in the position O, moves first through a distance, a, in a given direction and then through a distance, b, in another direction. Assume the body finally to be in the position C. The resultant displacement then is $OC = c$. The body would be in the same position, C, if it had moved first through the distance, b, and then through the distance, a, that is, its final position, or its final displacement is independent of the order in which the two displacements take place. They may take place, therefore, simultaneously, and the final or resultant displacement is still equal to c. If then we recognize that the two displacements have no mutual effect on each other, or, what amounts to the same thing, that the displacements are independent of each other, then the resultant displacement may be represented by the diagonal of a parallelogram of which the two displacements are adjacent sides. As soon as this "Principle of Independence" is once recognized, then the "parallelogram law" can be proved to hold also for velocities, accelerations and other conceptions of kinematics. The parallelogram law as applied to these quantities is then equivalent to the "principle of the independence of motions" and as such is a purely "geometric principle." These quantities, displacements, velocities and accelerations are therefore vectors in accordance with the definitions of a vector, and the principles of vector analysis may be applied advantageously.

Vector analysis may be called an algebra that rests on certain (arbitrary) assumptions, and the "parallelogram of vectors" is one of

these fundamental assumptions. To define a quantity as a vector, and then conclude that the parallelogram law holds begs the whole question. The logical way to proceed would be to first *prove* that the quantity is a vector, that is, that the parallelogram law holds and then (advantageously) apply the principles of vector analysis. We can not prove, however, that a *force* is a vector. We must depend upon experience for our justification in assuming a force to be a vector.

We do not know what a force is. To say that "force is an action" explains nothing, and to define it as a vector begs the whole question. Experience and experience alone can justify us in dealing with forces as vectors of a certain kind. In other words, the "parallelogram law of forces" is nothing more than an assumption and is *not* a purely "geometric principle." If we *assume* that a force can be measured by the motion it produces, and if we *assume* that the effect of each force is independent of the effect of the other forces acting, then it follows that the parallelogram law holds also for forces, since we know that this law, as a consequence of the principle of independence, does hold for the motions (accelerations) produced. This argument, however, makes two assumptions. First, it assumes that a force can be measured by the acceleration it produces (in its own line of action), and, secondly, it assumes "the principle of independence" for forces. Now these two assumptions are involved in Newton's Second Law of Motion. In other words, the parallelogram law of forces is a consequence of Newton's Second Law of Motion, and, therefore, in its last analysis is an assumption. If, however, the parallelogram law is once assumed for forces, then it can be proved for moments and other (vector) qualities involving force. It is, therefore, sufficient to *assume* the law to hold for *forces*.

It is a question whether we have a right to assume the parallelogram law even for velocities and accelerations without proving it, and to assume it for forces is equivalent, as we have seen, to assuming Newton's Second Law of Motion.

In my criticism it was stated:

> On page 102 he assumes that a force is proportional to the accelerations produced. This assumes Newton's Second Law.

In reply he says:

> This statement is not quite right. The relation between force and acceleration which I have called *force-equation* is derived on page 106 from the fundamental principle which I have postulated. In this derivation I have made use of the definition of kinetic reaction which is stated and illustrated on pages 102 to 105, but this is not equivalent to assuming a new principle.

This is true as far as it goes, but he fails to add that the form of this "force-equation" depends upon the actual value of this "kinetic reaction" which he finds as the result of experiments to be equal to the mass times the acceleration produced, that is,

$$\text{Kinetic reaction} = mf.$$

He seems to me to be making a "distinction without a difference." At least he is making an assumption here that is equivalent to assuming Newton's Second Law of Motion.

E. W. RETTGER

CORNELL UNIVERSITY

ACCESSORY CHROMOSOMES OF MAN

IN reply to Professor T. H. Morgan's statement in SCIENCE, June 5, 1914, I wish merely to request the reader who may be interested to read my note of May 15[1] and my paper, "Accessory Chromosomes in Man,"[2] and then Professor Montgomery's paper,[3] that he may decide for himself whether Montgomery and I have not agreed in the main regarding the accessory chromosomes of man. This was the only point at issue in my former communication, which was meant not as a "complaint," but as a correction to a misleading inference.

As to the material on which Montgomery and I came to different conclusions regarding a second pairing of the ordinary chromosomes, Professor Morgan is mistaken in stating that

1 SCIENCE.

2 *Biol. Bull.*, XIX., 4; September, 1910.

3 *Jour. Acad. Nat. Sci. Phila.*, XV., second series, 1912.

we obtained our results from "the same identical preparations." Montgomery never saw my preparations, nor I his. For a minor part of his work he used some material from the same individual I had worked on, but this material had been standing in alcohol some two years before he obtained it from me, so that it is to be expected that he would not get as clear-cut preparations as from freshly fixed material, to say nothing of the fact that fixation may have been unequal in different bits of the tissue.

Concerning the question of sex chromosomes in fowls, I may say that in my opinion the final word has by no means yet been said. I hope in the near future to contribute some further evidence in the matter.

M. F. Guyer

SCIENTIFIC BOOKS

Chemistry in America. Chapters from the History of the Science in the United States. By Edgar F. Smith, Blanchard Professor of Chemistry, University of Pennsylvania. Illustrated. New York and London, D. Appleton and Company. 1914. Pp. xiii + 354. Price $2.50.

In his preface the author says: "The writer has lectured for several years to his graduate students on the development of chemistry in the United States. A mass of material has been collected, most of which is not only interesting but valuable. Repeated requests have been made for the publication of these facts as a history of chemistry in the United States. To the writer's mind the information in his possession is not sufficiently complete to warrant such an important undertaking. The earliest endeavors of our country's scientists require even more careful and extended research."

The earliest contribution to chemistry from this country appeared September 10, 1767, in the *Transactions of the American Philosophical Society.* The title is "An Analysis of the Chalybeate Waters of Bristol in Pennsylvania." The author is Dr. John de Normandie. Liberal quotations from the article are given which show that the author used the balance. Then follow quotations from an article by James Madison, who was professor of chemistry and natural philosophy at William and Mary College as early as 1774, and from an article by Dr. Robert McCauslin. The author of the book thereupon remarks: "These communications testify to a spirit of inquiry, at least, on the part of our early devotees to science. They are, further, interesting in that they show the use of the balance as early as 1768 and indicate the steps of analysis."

In 1792 the Chemical Society of Philadelphia was founded by James Woodhouse. The fact is noted that the members of this society favored Lavoisier's doctrine of combustion.

According to Dr. Smith "the arrival of Joseph Priestley in America in 1794, and his frequent presence among the men of science of that day, greatly stimulated scientific studies." But Priestley's thoughts appear to have been on theological subjects fully as much as on scientific in these latter years of his life. He was elected professor of chemistry in the University of Pennsylvania in 1794 but felt obliged to decline the honor. In a letter to Dr. Rush in regard to this he says: "Nothing could have been so pleasing to me as the employment, and I should have been happy in your society, and that of other friends in the capital, and, what I have much at heart, I should have an opportunity of forming an Unitarian congregation in Philadelphia."

Thomas Cooper, professor at Dickinson College and afterwards at the University of Pennsylvania, was the first one to make metallic potassium in this country. He was also the editor of Thomas Thomson's "System of Chemistry." From 1820 to 1834 he was president of the College of South Carolina, "attaining distinction as an extreme advocate of the States' Rights doctrine during the nullification period."

Robert Hare, who was born in Philadelphia in 1781, was without doubt the most influential chemist of his time in America. In 1801, when he was only 20 years old, he communicated to the Chemical Society of Philadelphia a description of the oxy-hydrogen blowpipe which

afterwards came to be known as the compound blowpipe. The communication is entitled "Memoir of the Supply and Application of the Blow-pipe, Containing an Account of the New Method of Supplying the Blow-pipe either with Common Air or Oxygen Gas; and also of the Effects of the Intense Heat Produced by the Combustion of the Hydrogen and Oxygen Gases." Of this Dr. Smith justly remarks, "It is a real landmark in scientific discovery."

Hare later became professor in the University of Pennsylvania which position he held until his resignation in 1847.

Due reference is made to Benjamin Silliman, John P. Norton, Evan Pugh, Robert E. Rogers and Theodore Wormley. James C. Booth is spoken of as probably the first American to study analytical chemistry in Germany. "With an education probably unequalled at that time by any chemist in America, he returned to the United States, and, in 1836, established in Philadelphia a laboratory for instruction in chemical analysis and applied chemistry."

Of T. Sterry Hunt (1826–1892) the author speaks as "an active participant in the upbuilding of chemistry in America." J. Lawrence Smith (1818–1883) was active about the same time. His paper on a method of analyzing silicates by the use of calcium carbonate and chloride "was a very valuable contribution to analytical methods."

Frederick A. Genth (1820–1893) was a German by birth. He came to this country in 1848. After "conducting a laboratory for commercial analysis and the instruction of special students in chemistry, he became professor of chemistry in the University of Pennsylvania in 1872.

"His earliest contributions were upon geological subjects. Later he devoted much time to mineralogical problems. The chemical research by which he is best known relates to the ammonia cobalt bases (the cobaltamines) developed jointly with Wolcott Gibbs. His original memoir was published in 1851 and contained the first distinct recognition of the existence of perfectly well defined and crystallized salts of the ammonia cobalt bases. The joint monograph of Genth and Gibbs appeared in 1856. This elaborate and extended research has always stood among the finest chemical investigations ever made in this country."

"Wolcott Gibbs (1822–1908) for years held the most commanding position among the chemists of the United States."

"It was Gibbs's peculiar merit, that he, more than any other man, introduced into the United States the German conception of research as a means of chemical instruction."

His investigations covered a wide range of subjects in organic, analytical, organic and physical chemistry. "It was in the great research upon the ammonia cobalt bases, to which reference has already been made, that Gibbs finally found himself."

His most important contribution to analytical chemistry was the electrolytic determination of copper now universally used. "The entire field of electro-analysis was thus thrown open by him." His remarkable series of researches upon the complex inorganic acids, the publication of which began in 1877, continued well into the 'nineties.

Gibbs undoubtedly exerted a powerful influence upon the development of chemistry in this country. His sympathy with young men, his enthusiasm, his absolute fidelity to the highest ideals deeply affected many a young worker and helped to hold him on a true course.

Others whose work is discussed in the book before us are Albert Benjamin Prescott, Samuel W. Johnson (1830–1909), a pioneer in agricultural chemistry, John W. Mallet (1832–1912) of the University of Virginia, M. Carey Lea (1823–1907) and Josiah Parsons Cooke (1827–1894) of Harvard.

The book closes with some account of J. Willard Gibbs (1839–1903) of Yale, whose contributions to physical chemistry "are fundamental in nature and of broad application."

Dr. Smith has wisely refrained from speaking of those who are still alive. In conclusion he says: "It is not the writer's purpose to discuss the investigations which have come from the many working centers of the United

States during recent years, that story awaits another narrator; but, if only a desire, on the part of Americans to learn more concerning the place which American chemists occupy in the world's history of chemistry, is awakened, this compilation of facts will not only have been a pleasure but it will have served a worthy purpose."

The book is to be regarded as a "compilation" and not as a history. All American chemists should be thankful to the author for the pains he has taken to collect this material and for placing it before us. It furnishes the basis for the history of chemistry in America which remains to be written.

It is interesting to note the fact that so many of those who are necessarily mentioned in the book were connected with the University of Pennsylvania. It is, therefore, most appropriate that this work of compilation and comment should have been done by the one who at present holds the two important positions in that university of provost and professor of chemistry.

Ira Remsen

Das Relativitätsprinzip. By Lorentz, Einstein and Minkowski. Leipzig: B. G. Teubner. 1913. Pp. 89.

Under the general title Fortschritte der mathematischen Wissenschaften in Monographien, Otto Blumenthal is issuing a series of which number 2 is a collection of six papers by eminent advancers of mathematical physics dealing with relativity.

The first paper is a short note by Lorentz of date 1895 in which the hypothesis of shortening in the direction of motion is discussed, practically for the first time, though both he and FitzGerald had for some time been familiar with it. The second is a translation of Lorentz's very famous Electromagnetic phenomena in a system moving with any velocity smaller than that of light, dated 1904. Here not only the hypothesis of shortening, but the Lorentz group, fundamental in relativity theory, is found.

The third article is Einstein's epochal formulation (1905) of the principle of relativity as a fundamental physical principle independent of any hypothesis of shortening. He goes right at the heart of the matter in that direct way which has been so characteristic of his theories. The next is a short note, not two and one half pages, in which Einstein points out that a consequence of the foregoing work is the proportionality of mass and energy.

Minkowski's Raum and Zeit (1908) is the fifth article. Here the simple four-dimensional formulation of mechanics and of the inverse square law of attraction is first clearly exhibited—yet not so clearly that Sommerfeld's explanatory notes are unwelcome. This address of Minkowski's had been reprinted separately, and to the exhaustion of the edition is perhaps due the publication of the present collection.

The final article is from Lorentz's Alte und Neue Frage der Physik (1910) and forms an appropriate close to a series which presents concisely and at first hand the steps in the development from the Michelson experiment to the full fledged theory of relativity.

E. B. Wilson

Controlled Natural Selection and Value Marking. By J. C. Nottram. New York, Longmans, Green and Co. 1914. Octavo. Pp. 130.

The author of this book advances a new theory to account for the origin of sexual dimorphism and of polymorphism within animal species. He starts with the assumption that the competition in the struggle for existence is frequently between groups rather than between individuals. Thus, family may compete with family, or pair with pair, rather than individual with individual. Conspicuousness on the part of one member of the family (its least necessary member) it is supposed, may insure persistence of the family by drawing the attacks of enemies to the one and thus diverting them from the more valuable members of the family. Thus male conspicuousness, in sexually dimorphic species, is supposed to be advantageous to the female and young. "Controlled natural selection ac-

counts for both the origin and purpose of secondary sexual characters in the following way. Males are more conspicuous in nature than females: males are less valuable than females. Males and females are associated together during life, and especially during the breeding season when the difference in color is greatest, and when their difference in value is highest; therefore according to the theory, the conspicuous color of the male serves to control natural selection in such a way that the less valuable male will be killed in preference to the more valuable female."

It is assumed that if the male is taken, the female and young will *not* be taken. But the reader might reasonably inquire how the family would be benefited by the loss of its strongest member, and how the survivors would be protected after his demise. Is it to be supposed that the appetites of all enemies will be permanently appeased by a single meal, and that the father having been taken the family will not be further molested?

Not only conspicuousness due to color but also such as may arise from movement, sound or scent is interpreted in this same way. This puts a new meaning on courtship and other means of display and on song, which are all supposed to be protective to the family in which they occur by causing the destruction of those individuals which thus advertise themselves, which result is then supposed to give the others a better chance to survive.

For illustrations in support of his theory the author relies chiefly upon British birds, though reference is frequently made also to insects.

W. E. CASTLE

PUBLICATION OF THE AMERICAN EPHEMERIS AND NAUTICAL ALMANAC FOR 1916

THE *American Ephemeris and Nautical Almanac* for the year 1916, recently issued by the U. S. Naval Observatory, differs materially in construction and arrangement from previous numbers of this publication.

The preparation of this volume marks the inauguration of the scheme of cooperation adopted by the congress of representatives of the various national Ephemerides held at Paris in 1911. In accordance with this agreement a portion of the material contained in the volume for 1916, including the greater part of the Greenwich Ephemerides of the moon and planets and the apparent places of the stars, has been supplied by the foreign almanac offices, while the office of the American Ephemeris has in turn furnished to all foreign offices the data regarding eclipses, occultations, physical ephemerides of the sun, moon and planets, etc. This system of exchange reduces considerably the amount of duplication of work by different computers, and will, it is believed, prove mutually beneficial to the offices concerned.

Congress has, however, in the law authorizing this exchange, provided that any such arrangement shall be terminable on one year's notice and that the work of the Nautical Almanac Office during the continuance of any such arrangement shall be conducted so that in case of emergency the entire portion of the work intended for the use of navigators may be computed by the force employed by that office, and without any foreign cooperation whatsoever; and that employees whose services in part can be spared on this account may be employed in improving the tables of the planets, moon and stars, to be used in preparing for publication the annual volumes.

A rearrangement of the material contained in the first part of the Ephemeris has been made, with the view of giving it in better and more convenient form for the astronomer. Instead of giving portions of the ephemerides of the sun and moon alternately, month by month, there is now given for the entire year first the ephemeris of the sun complete, then the ephemeris of the moon complete, then the ephemeris of each of the seven major planets.

Other changes worthy of note are the following: Daily ephemerides are given for 35 circumpolar stars instead of 25, and they have been arranged in more convenient form. The apparent right ascensions of stars whose declination is less than 60° are given to $0.^s001$, and the apparent declinations of all stars are

given to 0."01. The data relative to eclipses, occultations, physical ephemerides and satellites, are given in Greenwich time instead of Washington time. The style of type adopted permits the publication of much of the material in a more condensed form without loss of legibility.

The preparation of the material for the *American Ephemeris and Nautical Almanac* for 1917, on the same general lines as the volume for 1916, is now well advanced.

J. A. Hoogewerff
U. S. Naval Observatory

BOTANICAL NOTES

FOREST TREE DISEASES

A handy little field manual for the practical use of foresters has been prepared by E. P. Meinecke, forest pathologist, in the Bureau of Plant Industry of the United States Department of Agriculture, under the title "Forest Tree Diseases Common in California and Nevada." In less than 70 pages the author manages to call the attention of the reader to about twenty-five diseases of various parts of the tree, and to give some general notions as to the nature of disease in plants, and the structure of the fungi which cause most of the tree diseases. Twenty-four half-tone reproductions of photographs help to make it easier for the young forester to identify the particular trouble he may have in hand.

ANOTHER TREE BOOK

Appealing largely to foresters also, Professor J. H. Schaffner's "Field Manual of Trees," may well be noticed here. For the region covered (Virginia, Kentucky and Missouri northward, and westward "to the limits of the prairie") we do not know of a more useful little book than this. In about 150 pages the author makes it possible for the reader to determine the name and relationship of the native and more commonly cultivated trees of the northeastern United States. It should find a large use in the high schools of the country, and the young forester will find it a most handy book to have in his pocket when he goes into the woods.

A PHARMACEUTICAL BOTANY

In a little more than one hundred pages Professor H. W. Youngken and F. E. Stewart have condensed the principal morphological and taxonomic portions of botany that they deem should be known by the student before he enters the field of pharmacology. As a hand-book to accompany a course of lectures this little book should prove very helpful, and apparently this was the purpose the authors had in mind when they prepared the text. We imagine that this booklet or one something like it might prove useful in other applications of science, as in agriculture, horticulture, agronomy, medicine, etc.

FLORA OF SOUTHEASTERN WASHINGTON

More than a dozen years ago Professors Piper and Beattie, of the State College of Washington published a useful little book under the title "Flora of the Palouse Region," and now they bring out a revision and extension of that work as the "Flora of Southeastern Washington and Adjacent Idaho." In its present form it makes an octavo book of nearly three hundred pages of close, and rather small type. In all 1,139 species are described, and it should be understood that they are *described* and not merely indicated by keys, as is so commonly the case in recent local floras. In fact this is a genuine manual of the systematic botany of a particular region. There is a general key to the families at the beginning of the book, followed by descriptions of the families (with keys to the genera), descriptions of the genera (with keys to the species), and finally good descriptions of the species. The nomenclature is modern and all specific names are decapitalized. It is a most creditable piece of botanical work.

MORE FLORIDA MANUALS

Some time ago (February 27, 1914) we noticed the botanical activity of Dr. J. K. Small in the preparation of manuals of systematic botany, from the ponderous "Flora of the Southeastern United States," to his "Flora of Miami," "Florida Trees" and "Flora of

Lancaster County" (Penn.) and now we must add two more similar books to his credit. They are the "Flora of the Florida Keys" and the "Shrubs of Florida" both of which appeared within the last few months. The first is a neat little volume of about 160 pages containing descriptions of the seed plants growing naturally on the islands of the Florida reef from Virginia Key to Dry Tortugas, a distance of about 225 miles. As the author remarks, "we find here a tropical flora made up almost wholly of West Indian elements, and closely related to the floras of Bermuda, the Bahamas and Cuba." To a northern botanist it seems strange to find among the grasses no species of *Poa*, nor of *Bromus;* in the sedges no species of *Carex;* in *Brassicaceae* but four species; in *Rosaceae* no species; while the leguminous families aggregate 57 species; *Euphorbiaceae*, 45 species; *Malvaceae*, 17 species, and *Rubiaceae*, 22 species. Of the three families of composites there are but 44 species.

In the other little book (of 140 pp.) the northern botanist will be astonished to find a shrubby grass [*Lasiacis* (*Panicum*) *divaricata*], a buckwheat (*Coccolobis*) forming "evergreen shrubs or trees," the Castor-oil plant (*Ricinus communis*) "a small tree or shrub," a shrubby heliotrope (*Heliotropium*), and a low shrubby *Eupatorium*. Both books will well repay careful examination.

SHORT NOTES

AN interesting paper by Dr. W. B. McDougal on "The Mycorhizas of Forest Trees" appeared in the first number of the new *American Journal of Forestry* showing that in some cases the relations between the tree and the fungus is symbiotic and sometimes parasitic.

FREDA M. BACHMANN'S paper on "The Origin and Development of the Apothecium in *Collema pulposum*"[1] is a valuable contribution to the theory as to the phylogeny of the Ascomycetes propounded by Dr. E. A. Bessey,[2] in which he suggested that the first Ascomycetes were lichens. In her paper Miss Bachmann says "in the number and nature of its spermatia and in the manner in which they are borne, *Collema pulposum* forms about the most perfect conceivable connecting link between the aquatic red algae with many non-motile male cells which are, however, set free, and such terrestrial ascomycetes as *Pyronema* and the mildews where the male cells are reduced in number to one or two which remain permanently attached."

[1] *Archiv. für Zellforschung*, Band X., Heft 4.
[2] *Mycol. Centralbl.*, Vol. III.

A RECENT handful of papers from Professor Doctor Aven Nelson reminds one of the taxonomic activity of the director of the Rocky Mountain Herbarium at Laramie, Wyoming, and serves to show that there is still much to be done in the systematic botany of the central mountains of the country.

DR. O. E. JENNINGS'S "Manual of the Mosses of Western Pennsylvania" (1913) should have been noticed long ago, since it offers to botanists in the central east a descriptive manual of these plants accompanied by fifty-four full-page plates of original drawings. The book includes somewhat more than four hundred pages, and is a credit to the author, and the institution (Carnegie Museum, Pittsburgh) from which it is issued. All told more than 275 species and varieties are described. The treatment is modern, the specific names being decapitalized, and "the rulings of the International Botanical Congress, held in Brussels in 1910, have been followed."

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

CELL PERMEABILITY FOR ACIDS

SINCE Overton's first extensive and well-known studies and his publication of the lipoid theory, interest in the subject of cell permeability has continually increased. Although adherents of the theory have modified and supported it with subsidiary hypotheses the two essentials remain unchanged to-day, namely—(1) that substances which are most soluble in lipoids (fat solvents or fat-like bodies) enter living cells most readily and (2) that they do so because they dissolve in the cell surface which is lipoid in nature.

Opinion concerning the lipoid theory is divided among those who deny the truth of both first and second statements; those who admit the first but not the second and those who accept the theory in its entirety.

The acids form a group of substances of particular interest in this connection in that they are bodies widely different in chemical composition and physical properties—lipoid solubility, degree of dissociation, surface tension—yet the entrance of each into a living cell may be detected by the same method—color change of a suitable indicator within.

It is impossible to stain living cells with dyes which will serve as indicators for acid, as I had previously done for alkalies,[1] so that recourse must be had to organisms with natural indicators. In plants the blue anthocyan pigments of petals are not sensitive enough to weak acids, such as acetic, to warrant their use. In animals despite the number and the variety in color of pigmented forms, indicators are very rare.

Last winter while a member of the Great Barrier Reef Expedition of the Carnegie Institution at Washington, I discovered a Holothurian, *Stichopus ananas*, the "prickly fish" of the Beche de Mer industry, whose viscera contain a purple water-soluble pigment turning red-orange in a concentration of acid between $n/1{,}000 - n/500$. The chemical composition of the pigment is unknown, but it appears related to the antedonin described by Moseley[2] from crinoids and a deep-sea Holothurian. The purple color is contained in sacs or bodies of unknown nature thickly scattered just under the epithelium covering the various viscera, and is especially abundant in the testes and ovaries, although not in the sperm and egg cells themselves. It is of importance to note that the pigment is contained in or surrounded by living cells and death of the tissue results in a rapid diffusion of the purple from the cells as in the case of so many other pigments. Acid diffusing toward the indicator must therefore pass through the layer of living epithelial cells.

A study of the penetration times of a large

Penetration Rate Tissues of "Prickly Fish" from $n/100$ Concentration		Toxicity to Cilia of Giant Clam[3]		Strength of Acid Percentage Dissociation at $n/128$ Conc.		Lipoid Solubility Equivalent Partition Coefficient Xylol/Water		Capillary Activity Surface Tension of n and $n/4$ Conc. where Water = 7.3 Mg.-Mm.		
								n	$n/4$	
¼ min.	Benzoic, Salicylic,	$n/2500$	Salic.	.96–.99	Nit.* Hydroc.* Tric.	2.5	Benz.	?	?	Benz.
		$n/1666$	Benz. Monoc. Dic.			1.3	Salic.	?	?	Salic.
2–4 min.	Valeric (iso-), Monochloracetic, Dichloracetic, Trichloracetic, Formic,	$n/1111$	For.	.88	Sulph.* Dic.	0.6	Val.		3.56	Val.
						0.1	Buty.*	3.30	4.39	Buty.*
						0.02	Prop.*	4.82		Tric.
		$n/1000$	Tric. Sulph.* Tart.*	?	Oxal.*	0.015	Monoc.[4] Dic.[4] Tric.[4]	4.82	6.13	Prop.*
				?	Phos.*			5.20		Dic.
9–11	Nitric, Hydrochloric, Sulphuric, d-Lactic, l-Lactic,	$n/909$	Val.*	.67	Maleic*			6.00		Monoc.
				.58	Malon.*	0.005	Maleic*[4]	6.04	6.81	Acet.*
			Nit. Hydroc. d-Lac. l-Lac. Fum. Glyc. Maleic Malon. Malic Cit.	.35	Monoc.				7.07	Malon.*
12–15	Fumaric, Oxalic, Glycolic,			.30	Fum. Tar. Salic.* Cit.				7.11	Maleic*
								6.83	7.14	For.
		$n/833$							7.17	Malic*
20	Maleic,			.20	Malic				7.24	Glyc.
30	Malonic, Tartaric, Phosphoric,			.13	Form.* Glycol. d-Lac. l-Lac.			7.19	7.27	Nit.
								7.25	7.28	Hydroc.
								7.27	7.30	Sulph.
									7.27	Oxal.
40	Malic, Citric,		Acet. Prop. Buty.	.08	Buty.*			7.27	7.29	Tart.
		$n/769$							7.27	Cit.
45–60	Acetic, Propionic, Butyric,	$n/400$	Phos.*	.04	Val.* Acet. Prop. Buty.					

[1] *Jour. Exp. Zool.*, Vol. 10, 1910.

[2] *Quart. Jour. Microscop. Science*, Vol. 17, 1877.

[3] Conc. which just kills in 20 hours.

[4] Insol. in xylol from $n/100$ conc. in water but slightly sol. from $n/10$ conc. Remaining acids insol. from $n/10$ conc. in water.

series of acids, organic and inorganic, was made and the results are given in the table on p. 948. Pieces of the testis, a branched filamentous organ, were placed in a $n/100$ concentration of acid and the time for color change noted. In addition the partition coefficients of the acids between xylol/water was determined as a measure of the lipoid solubility. Only a very few acids will pass to xylol from $n/100$ concentration in water and a few more from $n/10$ concentration. The strength of the acid (after Ostwald), its effect in lowering the surface tension of water (after J. Traube) and its toxicity for cilia (studies of my own carried out in Torres Strait) are also included in the table. The acids are arranged in order of efficiency in each case. Those with nearly the same effect or property are tabulated in groups and in an order to correspond as nearly as possible with the penetration series. An asterisk marks the acids considerably out of place in each series as compared with the penetration series.

With the exception of benzoic and salicylic all the acids encounter a resistance—small for some, greater for others—at the cell surface. If the tissue has previously been killed this resistance is abolished and the cells become readily permeable for all acids. The specific permeability of the tissue for each acid is therefore dependent on the living cells.

It will be noted that there is no exact quantitative agreement between any two of the series. The best agreement is between penetration rate and toxicity; the worst between penetration rate and degree of dissociation. One may conclude that those acids are most toxic which are able to penetrate the cell most rapidly, a conclusion supported by my results with alkalies. In neither case is there a relation between toxicity and dissociation.

As regards the lipoid theory my results can not be said to wholly support it; neither do they wholly contradict it. The same statement applies to Traube's Haftdruck theory. There is a general relation between the power to lower the surface tension of water (capillary activity) and rate of penetration, but it is not exact. With acids as with dyes and so many other substances, Overton's theory applies in the majority of cases, but not in all. In my opinion this can only mean that the power of penetration of an acid depends on several variable factors. One of these is lipoid solubility or capillary activity, for the two run more or less parallel, and a second is the strength or affinity of the acid for certain protein substances of the cell surface. This would explain the rather rapid penetration of strong acids little soluble or insoluble in lipoids.

E. NEWTON HARVEY

PRINCETON, N. J.,
April 28, 1914

A DESTRUCTIVE STRAWBERRY DISEASE

MANY of the long-distance strawberry shipments of this season have suffered serious injury culminating in a condition designated by the consignees as "molds" or "leaks."

In case of mold the berries, one or more per box, often quite the whole contents of the box, are more or less densely covered with a hairy mold.

The term "leak" designates a condition in which a liquid issues copiously from the bottom of the box. "Leaks" are accompanied by a soggy condition of the berries which mat down to occupy only one third or one fifth of their original volume.

The loss occasioned by these conditions is very large and will in all probability reach well into the millions this season. The berries now so affected originate in Louisiana and Mississippi. Data are not available concerning conditions in other states. The conditions mentioned have not occurred in previous years to sufficient extent to attract the marked attention of the buyers or inspectors though it is hardly to be supposed that they have been entirely absent.

The writer on April 30, acting for the Illinois Central Railroad, visited the berry region of Louisiana to ascertain the condition, the cause, and to render any assistance possible.

A preliminary examination at Hammond, La., May 1, of berries which had been in refrigerators over night, which had been picked

about eighteen hours, showed that these berries on an average exhibited two or three per box with very small rotten spots, perhaps 2 to 3 mm. in diameter though only rarely, even under the lens, was any mold apparent.

Visits to the fields showed many berries, green as well as ripe, rotting and molding while still on the vines.

While several types of fungi were present the one which was most characteristic was a *Botrytis,* probably *Botrytis cinerea.*

In the disease history, typically, the rotten spot appears, attains a size of several millimeters. Then a slight surface mold visible under the lens comes over the spot. Later the center of this area becomes coated with the typical *Botrytis* conidia, the whole berry becoming rapidly involved.

In late stages the picture may become complicated by invasion of other fungi, particularly by *Rhizopus nigricans.*

The sorters on the berry farms throw out most of the infected berries and these may be seen, bushels of them, near the sorting benches. Such discarded berries when several days old were almost always covered with *Botrytis* spores and the refuse heap reminded one of an immense culture dish of this fungus, though invariably contaminated by *Rhizopus.*

To ascertain whether apparently sound berries were really infected culture chambers were improvised of jelly jars with the aid of absorbent cotton.

The following tests were made in such dishes:

1. A large number of berries showing incipient decay but with no mold visible under the lens, were cultured. In twenty-four hours every berry showed profuse mold in nearly all cases of the *Botrytis* type; in a few cases other and various types.

2. A large number of apparently healthy berries, fully ripe, but carefully selected were cultured. These at twenty-four and at forty-eight hours showed no mold.

3. A large number of ripe healthy berries were severely jammed, bruised and crushed then cultured. They showed no mold in twenty-four hours.

4. A large number of berries showing various imperfections, sun scald, blister, insect injury, imperfect fertilization but no rotten spots were cultured. No mold appeared.

5. Sound berries were placed half covered with water. No mold appeared in twenty-four hours.

All of the above tests were made at room temperature.

From the practically universal presence of the *Botrytis* on young infected areas and its predominance on the refuse heaps I believe that this fungus is the primary cause of the molding, that the *Botrytis* initiates the decay, opening the way to such other saprophytes as may be present; of such saprophytes, *Rhizopus* is by far the most prominent and most abundant.

Laboratory tests which I have since made show that a berry inoculated with *Rhizopus* will rot rapidly with the escape of a large amount of liquid. It therefore seems probable that the "leaks" are due largely if not entirely to *Rhizopus* invasion.

Both the *Botrytis* and *Rhizopus* have been separated in pure culture in my laboratory and further study of these as well as of the other berry fungi will be made.

In the way of prevention extremely rigid sorting should be emphasized and it would also be well to prevent the refuse heaps from becoming culture beds of the fungus. This can perhaps best be accomplished by liberal use of lime.

F. L. Stevens

Urbana, Illinois,
May 8, 1914

THE AMERICAN CHEMICAL SOCIETY

The forty-ninth general meeting of the American Chemical Society was held at Cincinnati, Ohio, Monday, April 6, to Friday, April 10. The meeting opened with a council meeting on the evening of April 6. Tuesday morning the general meeting of the society was held in the auditorium of the University of Cincinnati and was addressed by the Hon. Frederick S. Spiegel, mayor of Cincinnati, and by President Charles W. Dabney, of the University of Cincinnati, both welcoming the society to the city. President T. W. Richards, of

the American Chemical Society, fittingly responded. The society then held a general meeting, at which the following papers were presented:

"The Chemical Problems of an Active Volcano" (illustrated), by Arthur L. Day.

"The Chemical Fitness of the World for Life," by L. J. Henderson.

"Flame Reactions," by W. D. Bancroft.

"Chemical Reactions at Low Pressures," by Irving Langmuir.

At one o'clock the society adjourned for an excursion to the Filtration Plant of the Cincinnati Water Works, optional excursions being available to the following plants:

Andrews Steel Co., Wiedemann Brewing Co., Old "76" Distilling Co., Frank Tea and Spice Co., Heekin Spice Co., Icy-Hot Bottle Co., Cincinnati's New City Hospital preceded by car ride through suburbs, the Dolly Varden Chocolate Co., W. T. Wagners' Sons Mineral Waters.

In the evening, a complimentary dinner was given to the ladies attending the meeting, followed by a theater party. At eight o'clock, P.M., a complimentary smoker was held at the Hotel Sinton, with 550 members and guests present. Mementos were given to all those attending, and the smoker will long be remembered, especially for the interesting and witty entertainment provided by the local members, and by talent especially engaged for the occasion.

Divisional meetings were held on Wednesday morning and all day Thursday at the University of Cincinnati, at which 181 papers were presented, a special symposium on the teaching of organic chemistry being also held by that division.

Complimentary lunches were furnished on Wednesday and Thursday. On Wednesday afternoon the members were taken through the works of the Globe Soap Company and Proctor and Gamble, with the following optional excursions also offered, W. S. Merrell Chemical Co., Lloyd Library and Museum, Fleischmann Distilling Co., American Diamalt Co., Eagle White Lead Co., National Lead Co., Lunkenheimer Co. Brass Goods, the Zoological Gardens.

On Wednesday evening a symphony concert was given complimentary to the members of the society, and the immense Emery auditorium was filled to hear a concert, under the direction of Ernst Kuhnwald, which has had few superiors in the history of American music.

On Thursday evening, a banquet was enjoyed by the members at the Hotel Sinton, with some 300 present. The banquet was unusual in that especially fine music was furnished by soloists. A decoration particularly worthy of note was an immense American Chemical Society pin in blue and gold flowers.

On Friday a special train complimentary to the members of the society took them and their guests to Dayton to visit the works of the National Cash Register Company, where lunch was served to all of those attending, after which the train proceeded to the works of the American Rolling Mills, at Middletown, and from there to Cincinnati. This day's excursion was particularly enjoyed and the works visited were among the most interesting ever opened to the members of the society.

The meeting closed with the arrival of the members in Cincinnati, and will always be remembered by those present. The members and officers of the Cincinnati section made every effort to insure the comfort and entertainment of their guests, and their hearty good will will never be forgotten by the recipients of their hospitality.

Meetings of all of the divisions of the society, as well as the India Rubber Section and the Water, Sanitation and Sewage Section were held. Details will appear in the published program, as above stated.

The meeting was the largest spring meeting ever held in the history of the society, 658 members and guests being present.

The following are abstracts of the papers presented before the various divisions so far as they could be procured:

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

Floyd W. Robinson, chairman

Glen F. Mason, secretary

Address. FLOYD W. ROBINSON, chairman.

Standards of Food and Drug Chemists: EDWARD GUDEMAN.

The Determination of Mixed Carbohydrates in Infant Foods: T. M. RECTOR AND E. B. WETTENGEL.

In preparations containing mixtures of sucrose, maltose, lactose and dextrine, the sucrose is determined by loss of rotation after inversion with invertase. The dextrine is determined by loss of polarization after precipitation with lead acetate and ammonia. The combined polarization of the sucrose and dextrine is subtracted from the total polarization, giving the polarization of the mal-

tose and lactose. A copper reduction is then run on an aliquot of the solution and the amount of copper reduced by 1 gm. of the sample is calculated. From this value and the combined polarization of the maltose and lactose the percentages of these sugars are calculated by a formula.

The analyses of some commercial infant foods by this method are given.

The Determination of Tannin in Tea: H. C. Fuller.

The powdered tea is first extracted with petroleum ether, which is discarded, and then percolated with 50 per cent. alcohol. The alcoholic solution is precipitated with an excess of lead acetate solution and the whole made up to a definite volume. An aliquot of this is then taken and the excess of lead precipitated with hydrogen in the presence of sodium hydroxide, the lead sulphide being filtered into a tared Gooch, washed and dried over sulphuric acid. A blank is run at the same time and the difference in lead figures is a measure of the lead taken up by the tannin.

A Rapid Method for the Determination of Sodium Chloride in Butter and its Substitutes: T. M. Rector.

The salt is determined by titration with silver nitrate with chromate indicator, in a water solution of a weighed sample of butter in the presence of the butter fat. Some results are given to show that the butter fat does not interfere with the accuracy of the method.

A Rapid Method for the Determination of Unsaponifiable Matter in Fats and Oils: T. M. Rector.

The sample is saponified in the usual manner and the alcoholic soap solution diluted to an alcohol content of 55 per cent. The solution is then extracted with light petroleum spirit, the solvent evaporated, and the residue dried in vacuo and weighed.

Freedom from emulsification is claimed for this method.

The Determination of Caffein in Coffee and Tea: H. C. Fuller.

The sample is ground so that it will pass through a 60-mesh sieve and a weighed amount boiled with dilute hydrochloric acid; the decoction filtered and the extracting process repeated three times with boiling water. From the filtrate the caffein is removed with chloroform, after rendering alkaline with ammonia, and after recovering the solvent the crude caffein is dissolved in acid and precipitated with iodide, and finally recovered from the iodide precipitate by treatment with sulphite and shaking out with chloroform.

The Official Method for Determining Crude-fiber as Applied to Cottonseed Meal: Chas. K. Francis.

The Arsenates of Lead: H. V. Tartar and R. H. Robinson.

Methods have been developed for the preparation of pure lead hydrogen arsenate and lead pyroarsenate. All attempts to prepare lead ortho-arsenate have failed. A new basic lead arsenate has been prepared. The authors believe that lead ortho-arsenate is not a constituent of the ordinary commercial salts used as insecticides. The substance present which has been thought to be the ortho-arsenate is in reality the basic lead arsenate mentioned above. The specific gravity of pure lead hydrogen arsenate is 5.786 and of the basic arsenate is 7.10. Analytical methods have been worked out for the quantitative estimation of lead hydrogen arsenate in the presence of the basic arsenate. This paper will soon be presented in full for publication in the *Journal of the American Chemical Society.*

The Changes Produced by the Wrapping of Bread: H. E. Bishop.

The Determination of Lecithin-phosphorus in Macaroni and Farinaceous Articles: H. C. Fuller.

The macaroni is thoroughly softened with hot water, the mass treated with a large excess of alcohol, the liquid filtered and the solid substance treated with further portions of alcohol; the combined alcoholic solutions are evaporated and the residue extracted with ether, which dissolves the lecithin. Phosphoric acid is determined in the latter by ignition of calcium acetate and finishing in the usual way with ammonium molybdate and magnesium mixture.

Lobster Oil: H. S. Bailey and L. B. Burnett.

In the cooking of lobsters preparatory to canning there is always a layer of oil collected upon the top of the kettles. For a number of years it has been the custom of the packers to skim off this oil and sell it to the dealers in fish oil who doubtless mixed it in with their low-grade products. Through the kindness of Dr. W. D. Bigelow we were able last year to obtain a sample of this lobster oil. It is a bright orange red in color and has a characteristic fishy odor and taste. A search of the literature failed to reveal any mention of this oil, although König[1] states that the

[1] *Chem. Nahr-u-Genussm.*, Vol. II., p. 493.

fresh German lobster contains about 1.84 per cent. of oil.

An analysis of this particular sample gave the following results:

Specific gravity, 25°/25°	0.9255
Refractive index, 25°	1.4765
Iodine number	145
Saponification number	175
Soluble acids (as butyric)	0.65%
Saturated (solid) acids	10.5%
Unsaturated (liquid) acids	80%
Insoluble acids	88%
Acetyl value	16.9
Iodine number of unsaturated acids	160
Iodine number of saturated acids	1.5
Melting point (capillary tube) of solid acids	51.6° C.
Molecular wt. of unsaturated acids	315
Saponification number of acetylated fat	184

Tomato-Seed Oil: H. S. BAILEY AND L. B. BURNETT.

The rapidly increasing production of tomato pulp and catsup in the United States, and the fact that oil is already being made on a commereial scale from the waste tomato seeds in Italy, make an investigation of the composition of this oil very desirable. Last season a few pounds of tomato seeds were obtained, and pressed in an expeller of the continuous action type. The oil thus obtained refined and bleached easily and was apparently a satisfactory food oil.

The Digestibility of Corn Consumed by Swine: S. C. GUERNSEY.

Digestion trials to compare the digestibility of maize in the natural state, with that of the shelled and ground grain, the latter two forms being fed both dry and soaked, were conducted in 1909 with 10 heavy-weight swine, weighing about 200 pounds, in 1910 with the same number of light-weight animals weighing about 70 pounds, and in 1911 with 10 light-weight and ten heavy-weight hogs. Each year the different forms of maize were fed through four ten-day periods to the swine, which were kept in cages, five animals being fed at a time, each receiving one form of corn through a ten-day period. The apparent digestibility was determined by weighing and analyzing the feed and corresponding feces, the latter being collected in rubber bags attached to the animals by a harness. A charcoal marker was fed at the beginning and end of each period for identification of the corresponding feces. The light-weight swine digested whole-grain on cob, and shelled grain more thoroughly than did the heavy-weights, while the latter utilized the soaked ground grain to better advantage than did the former. With the light swine, the whole grain on cob has the highest digestion coefficient, then dry shelled, dry ground, soaked shelled and soaked ground grain, while with the heavy-weights the soaked ground grain has the highest digestibility, then dry ground, dry shelled, ear and soaked shelled corn. A remarkable correlation between digestibility and time required for digestion was found in the series of experiments conducted in 1909–10, brought to notice by observations on the interval between the feeding of bone-black and its appearance in the feces. In a general way, the higher the coefficient of digestion, the longer the time required for the feces to pass through the alimentary canal, and *vice versa,* which holds true with both classes of swine as a whole or as separate classes.

Chemical Changes Occurring During the Period of Silage Formation: RAY E. NEIDIG.

The investigation included studies of the principal chemical changes which occurred in three silos built of different materials. The period covered was the first three weeks after filling the silos. The rate of increase or decrease of the following substances was determined daily: volatile acids, non-volatile acids, soluble carbohydrates and alcohol. Daily analyses were made of the gases of the silos and temperatures were taken by means of electric thermometers buried in different parts of the silos. The results show that sucrose is hydrolyzed to invert sugar in the early stages of fermentation and then a very gradual loss in carbohydrates is noted. The soluble carbohydrates do not disappear entirely, however, and those remaining were identified as invert sugar. Along with the gradual diminishing of the carbohydrates there is a uniform rise in acidity; both volatile and non-volatile acids are formed, the latter predominating. The volatile acid consists mainly of acetic acid together with some propionic acid; the non-volatile acid is the inactive or racemic variety of lactic acid. Alcohol was found in small quantities in all silos in slightly varying amounts. The gas analysis showed a rapid production of carbon-dioxide after filling the silos, reaching the maximum during the first few days and then gradually decreasing. Oxygen, on the other hand, was found only in traces after the first three days. The temperatures were quite uniform in all silos, the maximum temperature observed being 32.8° Centigrade.

Preliminary Notes on the Curing of Cucumber Pickles: H. N. Riley.

The activities manifest in a curing tank of cucumber pickles seem all to depend upon the growth of certain bacteria, known as "lactic-acid bacteria." These seem to govern the rate of fermentation, or giving off of gas, and the production of acid. The rate of fermentation mechanically governs the rate of absorption of salt, which is also influenced, to some extent, by the size of the pickle. The growth of mold and yeast seems destructive as they destroy the acid which is the principal keeping factor in the brine.

A Rapid Graphic Method for Calculating Rations and Dietaries: D. L. Randall.

The different common foods were classified according to the weight of protein in a hundred calorie portion and were arranged graphically on cards so that the distance taken up by any quantity of a food is the same as that which represents the protein as plotted to a definite scale. By suitable manipulation of these cards one can determine the quantity of different foods in combination necessary to get a definite amount of protein and energy and can determine the composition of any mixture of foods, all this being done with no other calculation than the addition of simple whole numbers usually less than ten.

The Hydrolysis, under Pressure, of Sugar Solutions: W. S. Hubbard and W. L. Mitchell.

Notes on the Determination of Total Sulfur: Philip L. Blumenthal.

Barium in Various Plants: Nicholas Knight and Lester W. Rusk.

The leaves and stems of thirteen different plants and common trees have been examined and barium has been found in all of them. Twenty-five grams of the leaf or stem have been taken for each determination. The investigation will be extended to include plants from widely different localities.

The Non-uniformity of Drying Oven Temperatures: Lorin H. Bailey.

Tests on eight different types of drying ovens, including those heated by gas, electricity, hot water and steam, showed that only those ovens which are surrounded by boiling water and steam, or by steam alone, maintain uniform temperatures. Other ovens show maximum variations of from 15° C. to 24° C. throughout the drying chambers, and a range from 2° to 17° C. from the temperature indicated by thermometer inserted through the top of oven and ordinarily taken as the temperature at which the drying is done. It is the type rather than the price that makes a good oven.

The Analysis of Alkali Soils: C. N. Catlin.

The determination of "alkali," in soil, is one of the most important analyses the agricultural chemist in semi-arid countries is called upon to make, but there are no standard methods for the determination. The author has collected and made a comparative study of many of the methods now in use. The results in several cases were not even comparable, the percentage of water soluble solids by some methods amounting to several times that found by others. Chlorides corresponded approximately. The chief source of difference lies in the completeness of solution of sodium carbonate and of calcium sulphate, neither of which is dissolved easily and completely from the soil. The highest results were obtained by the method in use at the Arizona Agricultural Experiment Station. This consists in digesting 50 grams of soil with 800 to 100 c.c. of water for ten hours on the boiling bath, whereby a constant and complete extraction of water-soluble salts is secured. Aside from the difference due to completeness of extraction, large discrepancies were found in determining sodium carbonate.

Dates: Comparative Cost of, in Akron, Ohio: Chas. P. Fox.

The Composition of Gooseberries, with Special Reference to their Pectin Content: E. H. S. Bailey.

Some preliminary analyses have been made upon a variety of wild spiny gooseberries that grow abundantly through northern latitudes. The interior of the half-ripened berry; the condition best suited to jelly making, consists of a firm, hard, glistening mass, with but few seeds. In order to obtain the juice it is necessary to boil the crushed berries repeatedly with water. On a large scale the berries yield 9.88 per cent. of insoluble material, including skins, seeds and short stems.

A preliminary analysis of the berries gives:

	Per Cent.
Dry solids	19.42
Ash	.87
Ash, soluble in water	.87
Ash, insoluble in water	.33
Proteins	1.37
Acid (as acetic)	1.27

Since pectins are precipitated by mineral salts, the question is raised to what extent the use of

hard water in the making of jellies reduces the pectin contact. Experiments in this line are being conducted. A bibliography of recent work is appended.

A Rapid Method for Commercial Analysis for Marls and Limestones: O. B. WINTER.

The commercial value of marls and limestones used for agricultural purposes depends largely upon their content of calcium and magnesium in the form of carbonates. Two methods are given for estimating lime—one, precipitating the calcium oxalate in the presence of oxalic acid, and the other, in the presence of hydrochloric acid. The carbon dioxide is determined by treating the sample with a small volume of hydrochloric acid and measuring the gas evolved. Results show that this method for carbon dioxide compares favorably with several other methods when certain precautions are used.

The magnesium is determined by calculating the amount necessary to combine with the carbon dioxide not taken up by the lime.

A Method for the Estimation of Calcium, Strontium and Magnesium in the Presence of Phosphoric Acid and Iron: O. B. WINTER.

Calcium and strontium are precipitated as the oxalates in a dilute hydrochloric acid solution. The oxalates are burned to the oxides, weighed and then nitrated and the nitrates weighed. The amounts of each (calcium and strontium) are determined as follows: (1) By separating the nitrates with absolute alcohol and ether. (2) By calculation from the amounts of oxides and nitrates. The magnesium is determined as magnesium pyrophosphate in the filtrate from the oxalates, by removing the ammonium salts and silica, and keeping the iron in solution by means of sodium acetate.

The Chemistry of the Decomposition of Peat and Muck: C. S. ROBINSON.

Some Pot Experiments with Mixtures with Peat and Manure in Connection with Various Fertilizers: C. S. ROBINSON.

BIOLOGICAL CHEMISTRY DIVISION

Carl L. Alsberg, chairman

I. K. Phelps, secretary

Coagulation of Albumen by Electrolytes: WILDER D. BANCROFT.

Colloidal Swelling and Hydrogen Ion Concentration: L. J. HENDERSON, W. W. PALMER AND L. H. NEWBURGH.

The Functions of Ammonium and Phosphoric Acid in the Regulatory Excretion of Acid: L. J. HENDERSON AND W. W. PALMER.

Partition of the Nitrogen of Plant, Yeast and Meat Extracts: F. C. COOK.

There is great variation in the precipitating power of the different reagents compared. Phosphotungstic acid precipitated the highest, tannin salt reagent the next highest and acid-alcohol the lowest percentage of the nitrogen of the seven plant, five meat and one yeast extracts examined. The formol titrated method gave lower results for amino nitrogen than the Van Slyke method. All of the methods showed a larger percentage of the nitrogen present in a more completely hydrolyzed state in the plant than in the other extracts. No kreatinin, and very little purin nitrogen was found in the plant extracts. The yeast extract was high in purin nitrogen, but contained no kreatin or kreatinin. The nitrogen of the plant extracts was found in the filtrate from the acid-alcohol reagent. Twenty-five per cent. of the nitrogen of the other extracts was precipitated by this reagent. The plant extracts showed more ammonia by the Folin method than the other extracts.

Comparison of the Various Methods for the Quantitative Determination of Sugar in Blood: MAX KAHN. (By title.)

Clinical Studies of the Russo Test: MAX KAHN. (By title.)

Urinary Catalase in Health and Disease: MAX KAHN AND C. J. BRIM. (By title.)

On the Presence of Oleic Acid in Gastric Contents of Patients Suffering with Gastric Carcinoma: MAX KAHN AND J. SUBKIS. (By title.)

The Lipins of Diseased Human Livers: J. ROSENBLOOM. (By title.)

The Potassium Content of Cerebrospinal Fluid in Various Diseases: J. ROSENBLOOM AND V. L. ANDREWS. (By title.)

A Standard in the Determination of Ammonia by Nesslerizing with the Dubosc Calorimeter: A. R. ROSE AND KATHERINE R. COLEMAN. (By title.)

Nephelometry in the Study of Nucleases: P. A. KOBER.

A Soluble Polysaccharide in Lower Fungi: A. W. DOX.

The Chemical Dynamics of Living Protoplasm: W. J. V. OSTERHOUT.

The Physiological Water Requirement and the Growth of Plants in Glycocoll Solutions: Alfred Dachnowski and A. Gormley.

Though it is not known precisely to what extent amino acids occur in peat soils, the question of the ability of plants to utilize directly nitrogenous compounds in the soil other than nitrates and ammonia is of considerable importance. The data presented show that the absorption of glycocoll is not connected with the transpirational water loss, but with the efficiency of the nutritive metabolism characteristic of the plant, and with the amount of water retained within the plant and involved in metabolism. Changes in body weight, if taken as the measure of growth, may be pronouncedly altered by the quantity of the metabolically retained water as well as by the deposition or removal of reserve materials in the tissues. The failure to promote continuous growth may be due to the inefficiency of glycocoll to supply material for tissue construction. This and the lack of available water enforce compensating processes in the plant. The apparently inevitable conclusion is entertained that the problem of the water requirement of plants and the criteria for the wilting coefficient, in particular the relation between the water content of the plant and that of the soil at the time of wilting, need to be reinvestigated more quantitatively than has heretofore been attempted. The retention of water, not transpiration, is the physiological function correlated with and indispensable to growth in general, and to survival and greater areal distribution of plants entering physically or physiologically arid habits. (To appear in *Amer. Jour. of Botany*, Vol. I., April, 1914.)

The Estimation of Amino Acids as Such in the Soil: R. S. Potter and R. S. Snyder.

Methods Adapted for the Determination of Decomposition in Eggs and in other Protein Products: H. W. Houghton and F. C. Weber.

The methods that were found most applicable for the determination of decomposition are the Folin titration and Nesslerization methods for free ammonia, Klein's modification of Van Slyke's method for amino nitrogen and Folin-Wentworth method for acidity of fat. Calculating the results on liquid eggs to a moisture-fat free basis, the following amounts of ammonia nitrogen in milligrams per 100 grams of material were obtained: By the Folin titration method, seconds gave, 11.4, spots, 14.1, light rots, 17.3, rots, 26.2, black rots, 169.6; by the Folin-nesslerization method, seconds gave, 12.4, spots, 20.0, light rots, 21.5, rots, 29.9, black rots, 148.6. The amino nitrogen determination is of service in detecting liquid and dried blood rings, spots and light rots. The increase in the acidity of the fat detects spots and worse grades of eggs. The ammonia methods applied to herring give results indicating decomposition of the fish after standing 24 hours at about 70° F. Applied to clams, an appreciable increase in the ammonia is shown after keeping two days at a temperature of 60° F. to 65° F.

Factors Influencing the Quality of American Sardines: F. C. Weber and H. W. Houghton.

This paper embodies some of the results of the observations and studies conducted at the laboratory established by the bureau of chemistry of the Department of Agriculture at Eastport, Maine, during the season of 1913. It does not refer to the packing of sardines in California. The chief factors responsible for the lack of uniform quality in oil and mustard sardines packed on the eastern coast are: Excessive pickling and salting, which removes a large amount of protein material (amino compounds), and lack of attention in securing a uniform degree of salting. Use of fish containing undigested food, particularly "red feed," which is the principal cause of broken and damaged fish. The steaming process, which removes a great deal of salt and flavor from the fish. Insufficient drying of the fish before packing, causing in the finished product a milky appearance of the oil, a slight soapy taste and the fish to be too soft. Variations in the composition of the fish at different times of the year and from different localities, particularly in regard to the fat content. Quantity and quality of oil used. Freezing and thawing of the packed goods. Considering all the possibilities, in connection with this industry, the most important of which is the packing for quality rather than quantity, as is done at present, it is believed that sardines can be produced in this country that are in every respect as good as the foreign sardines.

The Composition and Nutritive Value of the Proprietary Infant Foods: F. C. Weber and F. C. Cook.

Chemical, bacteriological and microchemical examinations were made of 36 proprietary infant foods. The nitrogenous constituents were separated and analyses were made of the water extracts and of the ash. The foods, prepared according to the manufacturers' directions for a three-month formula, were analyzed. Charts based on the analyses of the foods and on the three-month formulæ were prepared and the foods classified according to their composition and method of prepara-

tion for feeding. The results of feeding the three-month mixtures to rats, mice and kittens, and the nutritive value and ratios of these mixtures, were tabulated. The chemical deficiencies and abnormal nutritive ratios in some of the foods are confirmed by the results of the animal-feeding tests. Foods prepared with milk and water give uniformly better results than those prepared with water alone. A comparative study on puppies of the value of lactose and maltose was made.

The Electrical Stimulation of Tissue: OLIVER E. CLOSSON.

In using standardized inductorium for the faradic stimulation of tissue by the break induced shock it was found that the point in the primary circuit where the break is made and the distribution and nature of the resistance must be the same as used in standardizing. Keeping the same resistance in the primary circuit so that the open circuit potential difference and amperage remain unaltered, the position of the secondary in the region 50 cm. from the primary may be made to vary as much as 15 cm. for the same stimulating value by changing the point in the primary circuit where the current is broken or by changing the distribution of the resistance. In the secondary circuit the distribution of the electrical capacity is of very great importance in determining the beta unit of Martin. It is found that the stimulating value is greatest when the distribution of the capacity is such as to produce the greatest fall in the average absolute negative potential (electron potential) of the kathode and anode. The irritability was greatest with an anelectrotonic change, just the opposite to the usual electrotonic findings. It, however, conforms with the findings which point to the kations as being the important factor in stimulation.

A New Apparatus for Determining Crude Fiber in Foods, Feeding-stuffs and Feces: A. D. EMMETT.

In crude fiber determinations, it is often very difficult to transfer the last portion of the insoluble residue from the flask to the Gooch crucible or funnel. The use of the beaker is an advantage, not only from the standpoint of accuracy, but also with respect to the saving of time. The special feature of this apparatus is the arrangement which makes it possible to use a beaker. It consists of a specially constructed glass cone and rubber ring which prevents appreciable loss of water vapor during the boiling and thereby any increase in the concentration of the acid and alkali solutions. The inverted cone is attached to a Hopkins condenser with rubber tubing and the ring is snapped on to the lower edge of the cone. The condenser, cone and ring are then lowered over a 400 c.c. *lipless* beaker and adjusted until the connection between the rubber ring and beaker is tight. The entire apparatus is fastened in place by the clamp which holds the condenser. The glass cone is provided with a side-tube attachment which is so constructed that when air is drawn through the apparatus gently, the tendency to foam is greatly retarded.

The Carbon Dioxide Excretion as Modified by Body Weight: G. O. HIGLEY.

This work was done with the apparatus described in "The Carbon Dioxide Excretion Resulting from Bicycling," Higley and Bowen, *American Journal of Physiology*, XII., 4, page 311 (1904). There were nineteen subjects, students in the University of Michigan. The subjects, who had been engaged in laboratory work for several hours preceding the experiments, reclined for fifteen minutes preceding the putting on of the mask and the beginning of the record. The average excretion of carbon dioxide per kilogram of body weight was .0063 grams. Wide departures from this value seemed to be due (1) to an excessive amount of adipose tissue in the body of the subject giving *low* results, and (2) to colds and to indigestion giving high results.

Proteins of the Central Nervous System: H. H. MCGREGOR AND C. G. MACARTHUR.

A study of the proteins of the central nervous system has been conducted by drying the fresh tissue with an air current and removing a large proportion of the lipoids by cold solvents. After this treatment the solubility of the protein in aqueous solutions is found to be greatly increased, and the product precipitated by addition of excess of alcohol contains only slight amounts of lipoids. The protein obtained by this method contains phosphorus and has always given a slight though definite reaction for iron. Whether extracted by distilled water or by salt solutions, the protein is not precipitated upon dilution: the extract therefore contains no true globulin. Treatment with weak acetic acid yields an acid-precipitated and an acid-soluble fraction. The evidence from fractional heat coagulation and fractional salting out points to the individuality of the protein, instead of the presence of a mixture of nucleoprotein and globulin.

Enzymes of the Central Nervous System: H. M. ENGLISH AND C. G. MACARTHUR.

Enzyme extracts were made directly from fresh tissue by water, dilute acids, dilute alkalies, dilute salt and glycerine. After several days' standing with toluol or oil of mustard as a preservative, the extracts were examined. Lipase, peptase, nuclease, proteinase, peroxidase, arbutinase, salolase, dextrinase, were found to be present. Lipase gave activity on the following substances in the following order. Triacetin, monobutyrin, ethyl butyrate, olive oil, kefalin, lecithin. Sodium glycocholate, saponin sodium phosphate, were activators for lipase. The various divisions of the brain contained the same enzymes, but in different amounts. The cerebrum extract was several times as active as that of the medulla. Gray matter is much more active than white matter.

Specificity in the Action of Drugs on Brain and Heart Fosfatids: C. C. MacArthur and G. H. Caldwell.

If caffein, cocain, strychnin and other brain drugs show their specificity by some particular effect on brain kefalin and brain lecithin, these drugs ought to change the very sensitive calcium chloride precipitation limit of the fosfatid solution. Many series of determinations gave no such result. Digitalis strofanthin (etc.) should effect heart lecithin and heart cuorin solutions in a similar way. No consistent results of this kind were noticed. These results suggest that the fosfatids, in the condition isolated, are not concerned either through their solubilities, through changes in the state of aggregation, or through chemical combination in drug action. Probably these drugs effect more complex combinations or more labile groups of substances than those we isolate.

Reduction Processes in Plant and Soil: M. X. Sullivan.

Plant roots possess the power to reduce ammonium molybdate to the blue oxide MO_3O_8 and to reduce a mixture of para-nitroso-dimethyl aniline and alpha naphthol to naphthol blue. The first reduction is favored by a slightly acid medium and occurs predominantly within the parenchyme cells just back of the root tip. It is probably due to nonenzymotic products. The second reduction is not particularly localized, and is retarded by dilute acids, favored by dilute alkalies. Certain solids likewise have the power to form naphthol blue from the mixture of para-nitroso-dimethyl aniline and alpha naphthol. Soils possessing this power do not oxidize easily oxidizable substances such as aloin. Conversely, as far as investigated, soils acting on aloin do not form naphthol blue.

The Passage of Nucleic Acid from Plant to Medium: M. X. Sullivan.

In the water in which wheat had grown for sixteen days, with change of water every two days, material was found which was soluble in dilute alkali, precipitated by dilute acids and alcohol, contained phosphorus, gave the pentose reactions and on hydrolysis with dilute acid gave a reducing sugar and xanthine bases such as guanine, determined by color reaction and formation of the hydrochloride, and adenine, determined by color reaction. The material was judged to be nucleic acid.

Chemical Studies upon the Genus Zygadenus: C. L. Alsberg.

A number of species of plants of the genus *Zygadenus* are regarded as poisonous. Great confusion from the toxicological standpoint has existed in this genus because the nomenclature of this genus has not always been clearly understood. Thus the alkaloids of the "veratrine" group have been misnamed. It is not found at all from species of the genus *Veratrum*. *Veratrum* contains no veratrine, but, as is now well known, is a mixture of quite different alkaloids. The alkaloids of the "veratrine" group are, as is generally known, obtained from sabodilla seeds. These are the seeds of a species of *Zygadenus*. Hunt was the first to show that the *Zygadenus Venenosus* of the western United States contains the same or similar alkaloids. Slade confirmed this and Heyl and his collaborators obtained a crystalline alkaloid, apparently belonging to this group, from *Z. intermedius*. In the investigation herein reported, similar alkaloids were obtained in crystalline form from *Z. Venenosus, Z. elegans* and *Z. coloradensis*, all of them very toxic and with similar pharmacological action. From a member of a closely related genus, *Amianthium muscætoxicum*, a similar active principle was obtained in an impure state. Apparently many of the species of this group of lilies contain "veratrine" alkaloids or alkaloids related to it.

Nephelometry in the Study of Nucleases: Philip Adolph Kober and Sara S. Graves.

The nephelometer can be used for the study of nucleases, if an acid egg albumin solution is used as a precipitant. This reagent will reveal the presence of one part of yeast nuclei acid in 1,000,000 parts of water, and in practical work is not affected by most substances found in physiological work.

Charles L. Parsons,
Secretary

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